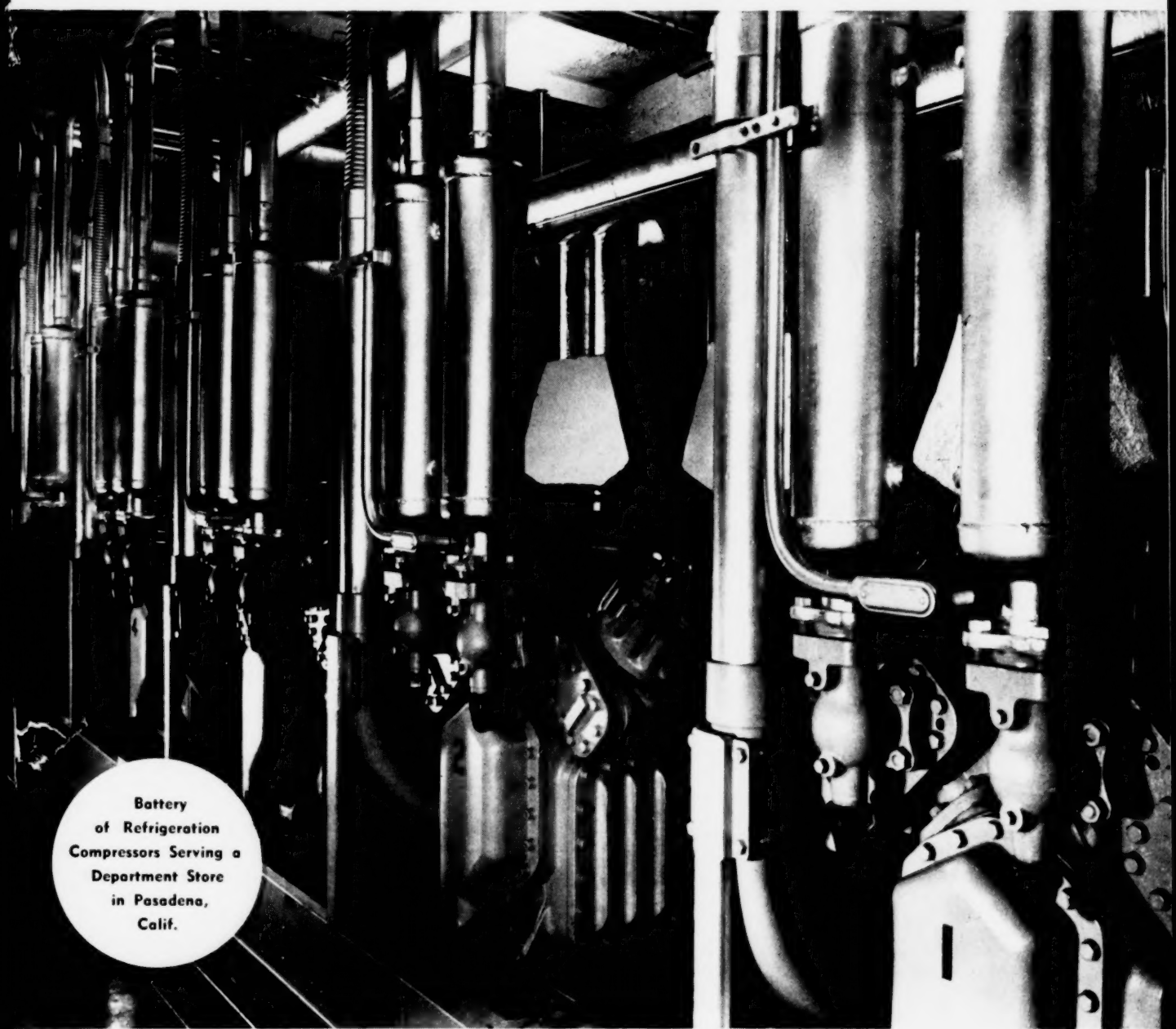
APRIL, 1953

HEATING AND VENTILATING

INCLUDING AIR CONDITIONING – PIPING – REFRIGERATION – AIR SANITATION



Battery of Refrigeration Compressors Serving a Department Store in Pasadena, Calif.

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Moving Air Through Ducts . . . . page 103

Starters for Electric Motors . . . page 111

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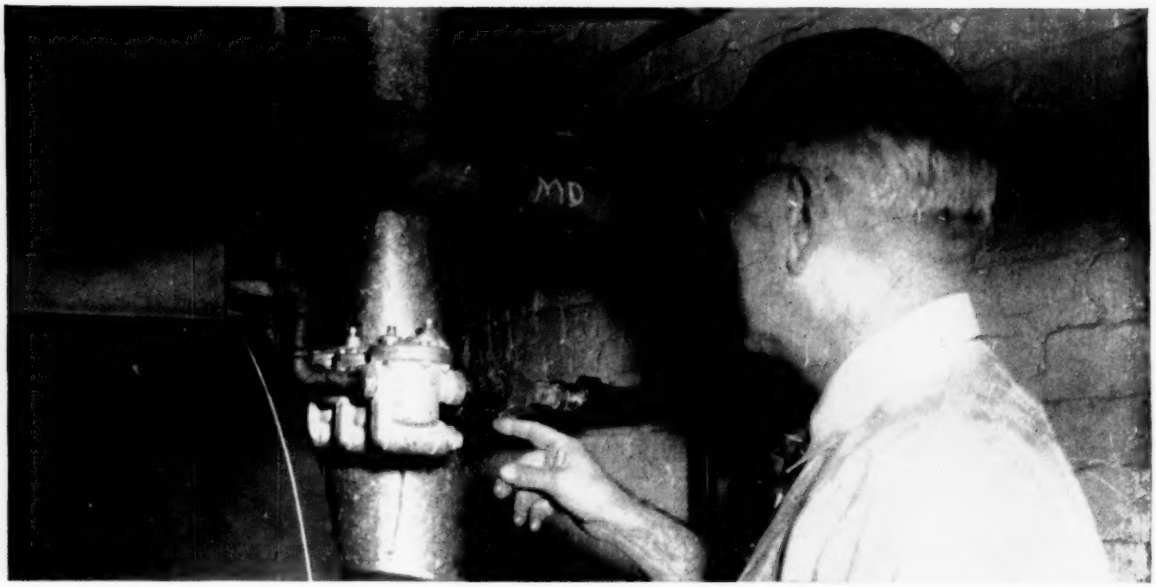
User Explains How Armstrong Unit Trapping Boosted Output:

Need for Investment in New Steam Equipment Eliminated by Only 550^{00} in Steam Traps



THIS is a story about greatly increased efficiency in a laundry, but the principles involved apply to any plant using steam heated equipment.

In speaking of the benefits derived from Armstrong Unit Trapping, Earl Fast of Soft Water Laundry and Cleaners, Long Beach, California, said, *"It's like a man with dirty eyeglasses—he thinks he's seeing perfectly until he cleans the glasses and finds out what he has missed."*

Mr. Fast's plant modernized its entire return system in 24 hours, installing 71 Armstrong traps costing about $550, with these results:

1. Capacity of machines costing as much as $15,000 per unit increased to the extent that new machines are not now required.
2. Higher quality of ironing and finishing, with touch-up on shirts eliminated.
3. Worthwhile fuel savings.

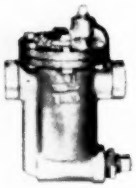
"Our boiler was turning out plenty of steam," continued Mr. Fast, "but we weren't getting the benefit of it. The best power plant in the world is of no value if you don't use its produced steam to maximum efficiency."

And there lies the case for Armstrong Unit Trapping, which discharges air and condensate as fast as it accumulates to keep steam heated equipment hot and producing at a peak rate. Your local Armstrong Representative will be glad to survey your condensate drainage system without obligation. Call him or write:

ARMSTRONG MACHINE WORKS

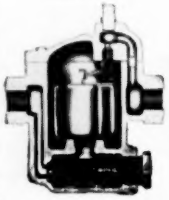
846 Maple Street • Three Rivers, Michigan

Traps with Built-in Strainers Cut Costs



Because the piping at Soft Water Laundry was old, the smallest-sized traps needed protection against dirt and scale. Armstrong No. 880 and 881 traps with built-in strainers were the logical answer because:

1. They cost less than a separate trap plus a strainer.
2. They eliminate external fittings and considerable installation labor.



Left—Cut-away view showing strainer screen at trap inlet. Strainer can be cleaned without removing or shutting off steam.

FREE
44-PAGE STEAM TRAP BOOK
Gives Complete Information
MAIL TODAY!

You always get more out of equipment when you use Armstrong "Unit Trapping"

FILL IN AND CLIP TO YOUR COMPANY LETTERHEAD

ARMSTRONG MACHINE WORKS
846 Maple Street, Three Rivers, Michigan
Please send me a Steam Trap Book.

Name .....

Title .....

Why CUMMINS ENGINE COMPANY specifies *Power-Flow* ROOF VENTILATORS

Embarking on a program of modernization and expansion for their plant at Columbus, Indiana, officials of Cummins Engine Company naturally planned for adequate, controlled ventilation.

Cummins started with four DeBothezat Power-Flow Roof Ventilators, selected for their low, streamlined appearance. This initial installation has been followed by many others until today 78 Power-Flows provide good ventilation for over 2,000 Cummins employees in machine shops and other production areas. 44 Power-Flows are for exhaust, 34 for air intake.

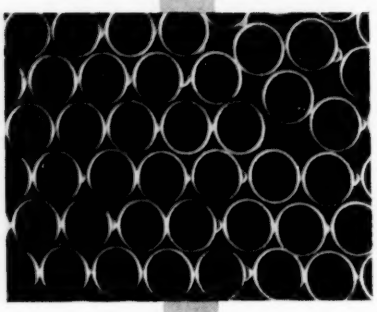
Why are the builders of world-famous Cummins Diesels so well satisfied with their roof ventilators? Because they found that Power-Flows perform exactly as advertised. The capacity ratings shown in our catalog are the capacities of the complete unit, including the weather head, NOT capacities of the fan alone. With Power-Flow Roof Ventilators you get all the air you pay for.

DeBothezat Power-Flow Roof Ventilator is a motor-driven fan in a weather-proof housing, for use with or without duct systems, either for air exhaust or intake. Available with fan wheels 12″ through 48″ in diameter, delivering up to 40,900 CFM. For catalog containing illustrations, specifications and certified capacity ratings, write our factory, Dept. HV-453, or phone your local DeBothezat agent.

DeBothezat Fans

Division of
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

What Proves the Worth of a Boiler Tube?



Claims of dependability . . . of consistently uniform wall thickness, diameter, and physical properties . . . of freedom from scale, slivers, pitting, and other defects inside and outside a tube, are common—*and true*—for all quality boiler tubes regardless of the mill that supplies them. They are true because *all boiler tubes must conform to the same specifications for the same jobs.* Side-by-side they're "look-alikes," yet there is a difference . . . a difference that only *time* can prove under the grueling conditions of heat, pressure, corrosion, and oxidation found inside a modern boiler. B&W boiler tubes have met this test of time in boilers serving the widest variety of applications . . . utilities, industries, government institutions, hospitals, office buildings, apartment houses . . . wherever fine boilers are operating efficiently over extended periods.

Say B&W before you say WELDED BOILER TUBES—for Service-Proved Dependability.

For three-quarters of a century, B&W has been directly concerned with developing and applying boiler tubes for lowest pressures up to those approaching 3000 psi. The application of this extensive knowledge and experience results naturally in the production of finer boiler tubes.

B&W dependability is proved by time and endorsed by hundreds of customers who keep coming back for more . . .

B&W WELDED BOILER TUBES.

B&W SEAMLESS and WELDED TUBES

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing

Alliance, Ohio—Welded Carbon Steel Tubing

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HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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The INDUSTRIAL PRESS

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HEATING & PLUMBING EQUIPMENT NEWS
and technical books.

THIS MONTH'S COVER

Five refrigeration compressors serve Bullocks Department Store in Pasadena, Cal. The system was installed by Western Air & Refrigeration, Inc., Los Angeles, Cal. Photograph, courtesy of Westinghouse Electric Corp., Air Conditioning Division, Hyde Park, Mass.

Washington News

LORING F. OVERMAN

DURING March in Washington the new crew proved that it was getting the feel of things. As promised, price controls were lifted completely, more than six weeks ahead of the April 30 deadline fixed in the legislation.

Plans for a new Defense Materials System—a substitute for the expiring Controlled Materials Plan—were also announced.

But in another sphere of promise—the one involving tax cuts—the new Administration was finding it difficult to deliver.

Two Schools of Thought

In the matter of cutting taxes, there are two approaches. One viewpoint, sponsored by Chairman Daniel Reed (R-NY) of the House Ways and Means Committee, is that the way to cut down expenditures is to pull the purse strings tight first. If the flow of money is cut off, he contends, expenses will just have to be cut.

The other viewpoint is that certain things are "musts", and that only after these have been provided can revenues be reduced by means of tax cuts. At the moment, President Eisenhower and many of his advisers seem inclined to this latter view. Specifically, Chairman Reed is standing pat for three things—allowing the excess profits tax to die on June 30 as per existing legislation; advancing to that date the 11% cut in personal income taxes scheduled for December 31, and above all—no new taxes.

The President, on the other hand, has insisted that if the Excess Profits tax is to be cut, and individual income tax reductions set forward, then some substitute revenue must be provided. At this writing, it appears to be settling down into a personal tug of war between the President and Chairman Reed. The outcome? Americans voted "against their pocketbooks", many feel, last November, and will more than likely support the President if he finally comes out in an appeal for a balanced budget before tax cuts.

Meanwhile, there is a feeling in Washington that a very honest effort is being made to cut government expenses. Watchdog committees in each branch of government have found ways to cut a few millions here, a few hundred thousand there. Contrasted with the $78 billion Truman budget, such cuts seem woefully small. But added together they could total up to the several billions which the new Administration hopes (and promised) would be cut if the public would only vote it the chance.

Apparently the only difference between the Daniel Reed viewpoint and that of the President's advisers is one of timing. Reed feels that the cut must be made right now; the President's group feels that the public would be content that help is on the way.

Defense Budget Under Review

With 60% of the budget earmarked for the Defense Department, much depends upon whether Defense Secretary Wilson and the Joint Chiefs of Staff can wring any water out of the military programs. Goal is to reduce the defense budget by $4.5 to $5 billion if at all possible. At a late-March press conference, Mr. Wilson said he felt some cuts could be made, but he declined to guess how much.

He said his department was determined to fill the requirements of the fighting front and to provide all arms and ammunition needed.

Civil Defense, $20 Billion?

Further complicating the problem of cutting defense expenditures is the newest Report of U. S. Air Defense Requirements, submitted recently to the President and the National Security Council. Attributed to the Massachusetts Institute of Technology, the report is said to recommend an air defense plan for the United States at a possible cost of $16 to $20 billion. Included is an elaborate radar screen, jet interceptor squadrons, dispersal of industry and populations.

The recent atom demonstrations in Nevada, particularly those phases picturing what can happen to residences, were said to be a part of the effort to convince an apathetic public of the need for more concern.

Defense Materials System Ready

Having announced that the Controlled Materials Plan is to end on June 30, Washington has whipped up a "simple" Defense Materials System to channel essential materials and controls into military hands after July 1. On paper, the holders of defense contracts get the priorities they need to do the job, with defense-supporting industries next in line. Trouble is, a simple priorities system never seems to work. Everybody wants to get into the act, and what starts out to be a simple system winds up as allout allocation. It is to be hoped that simplicity turns out to be more simple, after July 1, than it has been in the past.

Metals Price Decontrol Important

Since the military is to have the first fruits of the metals market, the share to be claimed is important to the price picture, now that OPS has relinquished all controls.

Steel for military purposes will require about 14% of the 88 million ton annual output. It is considered unlikely that this percentage will be a strong factor in forcing prices upward. Thus, unless wage scales change the present picture, indications are that steel prices will not climb much, if any, in 1953.

Aluminum for military use, exclusive of stockpiling, requires about 40% of supply. The new supply for 1953 is expected to reach 3.2 billion pounds. Compared with a 1952 total of 2.8 billion pounds, and a World War II high at 2.7 billion pounds, it would seem that the supply will be sufficient to hold prices at present levels.

Copper for military uses will require some 30% of supply—a total of about 2.7 million tons overall. Prices have already risen some 16 percent since decontrol, with scrap copper up 34%. The improved price is expected to

WOOD WON'T ROT WHEN IT'S COLD AND DRY

Living fungi, which break down the substance of wood are microscopic and abundant. But they need a certain amount of WARMTH and DAMPNESS to develop. Dampness will also peel off paint, crumble plaster, rust iron and steel.

Some insulations promote and retain destructive condensation inside walls and other structural spaces. In addition to warmth, vapor of water also flows through paper, plaster and most building materials, including ordinary insulations, and sometimes even through asphalt paper. Vapor condenses when it strikes a colder surface and reaches a dew-point.

An empty space is the best insulator against heat flow by Conduction; but does not prevent heat flow by Radiation and Convection. Of all heat transferred through structural spaces, 50% to 80% is by Radiation; all but 5% of the rest is Convection. Multiple accordion aluminum sheets throw back all but 3% of the Radiation which strikes them, and block Convection. Their insignificant mass, 1 oz. to the square foot, and their multiple air space construction, minimize Conduction.

They have zero permeability to water vapor and all other gases, including air, hot and cold. Because of their structure, they are practically non-condensation-forming, for a dew-point is not reached on any of their surfaces.

Simple and illuminating discussions of vapor and heat flow, including explanations of how to prevent timber rot, will be found in the 5th edition of "Simplified Physics of Vapor and Thermal Insulation," 56 pages of facts and figures.

The commercial forms of tough, multiple accordion aluminum sheets are Infra Type 6, Type 4, and Type 4 Jr.

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INFRA THERMAL FACTORS. TYPE 6

Up-Heat C.089, R 11.23 = $4\frac{3}{4}$" dry rockwool

Wall-Heat C.073, R 13.69 = $5\frac{5}{8}$" dry rockwool

Down-Heat C.044, R 22.72 = 9" dry rockwool

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Please send FREE "Simplified Physics of Vapor and Thermal Insulation."

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attract heavy imports, which in turn may prevent runaway quotations.

Price-Wage Freeze Bill Likely

Because the impact of military requirements could exert overnight pressure on wages, rents and prices, Congress seems convinced that some sort of power to call a halt should be provided. Currently popular is the "freeze" technique. This would provide the President authority to freeze prices, wages and rents as of a given date—possibly for 60 or 90 days. Such a period would provide Congress an opportunity to evaluate the "emergency" and to provide suitable legislation. Members of the Senate Banking Committee expected to report out a somewhat modified version by April 15. Among other things, committee members were expected to write in the requirement that the freeze could not be implemented except following a declaration of war, or threat of imminent attack.

Washington Miscellany

Senate Also Woos Small Business. The attention being given small business in Washington belies the accusation that the Administration is "big business". In recent weeks four divisions of government—Senate, House Atomic Energy Commission and General Services Administration—have called attention publicly to their concern over the welfare of the little fellow.

In the Senate John L. Sparkman, former chairman and now ranking member of the Senate Small Business Committee, proposed a three phase program which would include:

1. Tax concessions, including increasing the present $25,000 exemption under the excess profits tax; increasing the surtax exemption; eliminating corporate taxes on the first $10,000; giving tax credits up to specific amounts on funds returned to the business as capital investments; giving small business firms the choice of a more rapid writeoff of depreciation,

2. Continuation of the Small Defense Plants Administration as a permanent and independent small business agency,

3. Development of a new small business loan program to insure, through private lending agencies, loans made to small business. The loan program would be similar to that used in the housing programs.

AEC Promises Share of Orders. The Atomic Energy Commission and the Small Defense Plants Administration have concluded an agreement which promises to give smaller firms a better opportunity to participate in AEC business. Under the agreement, SDPA regional offices are to be provided by AEC with information on all procurement opportunities suitable for small business. In turn, SDPA will provide AEC and its contractors with the names of qualified small firms. The joint agreement calls for periodic reviews to determine whether the program is warranted and practical.

GSA Aids Small Business. The eleven service centers of the General Services Administration are "starting points" for small business firms seeking government orders. Function of the centers is to provide prospective bidders with full information on federal procurement practices, and all purchases of the General Services Administration and other agencies. The centers furnish copies of federal (military excepted) specifications, bid invitations, contract forms, plans and drawings, results of bidding, abstracts and tabulation of awards. Single copies of specifications may be secured without charge at the centers, with adoptional copies available at small cost from General Services Administration in Washington.

The centers answer approximately 100,000 inquiries every six months. Their service includes providing subcontractors with the names of bidders who have asked for drawings on prime contracts. The GSA business service centers are located at Boston, New York City, Washington, Atlanta, Kansas City, Chicago, Dallas, Denver, Los Angeles, San Francisco and Seattle.

Small Business Agency Proposed. Despite the Administration theme of reducing the size and numbers of government agencies, there's now a proposal in the hopper to form a new and permanent agency to be known as the Small Business Administration. Proponent of the idea is House Small Business Committee Chairman William Hill (R-Colo.). Mr. Hill believes that existing programs intended to aid small business overlap, causing inefficiency and unnecessary expense. Mr. Hill proposes that the new SBA be given a revolving fund of $50 million, which would be used to enter into contracts with other federal agencies, and to let subcontracts to small business firms. SBA would also be directed to keep up-to-date an inventory of facilities which small business could offer for war defense, or essential civilian production.

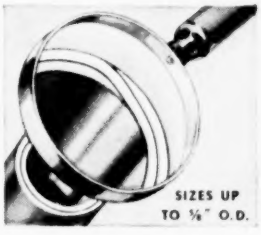
Gas and Oil Exploratory Committee. A 29-member Committee on Oil and Gas Exploratory and Development Requirements has been formed by the National Petroleum Council at the request of J. Ed Warren, Deputy Petroleum Administrator for Defense. The Council acts in an advisory capacity to the Secretary of the Interior and the PAD. Chairman of the new committee is Paul Endacourt, Bartlesville, Okla., president of Phillips Petroleum Co.

The committee is to study the minimum requirements for national defense (and assuming well drilling rates 10 percent above 1952), with regard to manpower, equipment and materials needed for all exploratory and development work. Such information, PAD officials explain, would be important to the country in the event of an emergency.

Coal Analysis Report Issued. A copy of the Report of Investigation 4934, "Analysis of Tipple and Delivered Samples of Coal (collected during fiscal year 1951)", may be obtained free from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa. The report induces analysis of samples of coal from mines in 19 states.

The Bureau maintains an open file of analyses for purchasing agents in Washington. The bureau explained that the coal-sampling and analyses service enables the Government (and civilian buyers) to award coal contracts on a guaranteed-quality basis, and to adjust prices when shipments fall below contract quality. During fiscal 1951 the government bought more than 5,000,000 tons of coal.

Market for Room Air Conditioners? Only 1.3% of wired homes had room air conditioners on January 1, 1953, according to Department of Commerce figures. Sales have risen each year since 1946, but have been held back somewhat by materials shortages.



Key to Low Cost

Bundyweld is the only tubing double-walled from a single strip, copper-brazed through 360° of wall contact. It's leakproof, thinner-walled, yet stronger. It transmits heat quickly, has high bursting strength. It saves on material costs and installation time.

Standard 20′ lengths of Bundyweld are easily formed into coils in shop or on job site. Expanded ends (furnished when specified) are quickly soldered into leakproof union. Joined, lightweight coils are easily mounted onto ceiling, quickly plastered over.

Beat the bandwagon . . . Take on Bundyweld Ceiling Radiant Heating NOW

Here today is the best chance ever to get the jump on your competitors . . . to beat the bandwagon they'll *all* be trying to ride tomorrow!

Start featuring Bundyweld Ceiling Radiant Heating now. Here's sales appeal! . . . heat that's as clean as a breeze, as refreshing and even as sunshine. Here's a tested, trouble-free system that gives the whole house—*every inch of it*—the same pleasant warmth. Yet it actually costs *less* to run.

It's no wonder buyers are getting excited about it . . . and they *are* getting excited! Millions of people all over the country are reading Bundy ads in *Better Homes and Gardens, American Home, Small Homes Guide,* and *House Beautiful.* Their requests for literature have rolled in like an avalanche. And everywhere buyers are writing for the names of plumbing and heating contractors who handle Bundyweld Ceiling Radiant Heating *in their areas.*

Somebody in your community is going to cash in on this tremendous wave of public enthusiasm. Why not you? Send for your Bundy literature today.

Radiant Heating Division

BUNDY TUBING COMPANY

Detroit 14, Michigan

SEND FOR FREE LITERATURE!

Bundyweld
Ceiling Radiant Heating

Radiant Heating Division, Dept. HV-453
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☐ Send free 20-page nontechnical brochure explaining Bundyweld Ceiling Radiant Heating.
☐ Send Bundy technical radiant heating pamphlet.

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Company _____
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City _____ Zone ____ State _____

BRIEFLY STATED

• J. F. Knoff has been appointed vice-president and general sales manager of Airtemp Div., Chrysler Corp., Dayton, Ohio. Mr. Knoff has been with the firm for nearly 8 years and since 1951 has served as general sales manager of this division. From 1929 to 1942 he was was Ford Motor Company, and in 1942 he joined Delta Ship Building Company in New Orleans.

• Two executives of C. A. Dunham Co., Chicago, Ill., have been elected directors of the firm's wholly-owned Canadian subsidiary. They are L. D. Mandell, vice-president and assistant to the president, and W. S. Browning, sales manager. Mr. Mandell joined the company in 1930 and Mr. Browning has been associated with the company since 1948.

• George W. Kelsey has been elected president of Builders-Providence, Inc., Providence, R. I. Mr. Kelsey came to the company in 1938 from U. S. Steel Corporation. He was at one time on the staff at Rutgers University as associate professor and prior to that an industrial engineer with Tide Water Oil Company.

• Dr. R. C. Ulmer, a feedwater specialist and for the last seven years technical director of E. F. Drew & Co., has joined the engineering department of Combustion Engineering-Superheater, Inc., New York City, where he will be engaged in development work. A graduate of Ohio State University, from which he acquired his doctorate, Dr. Ulmer spent some years as a chemist in the research department of The Detroit Edison Company, where he was associated with power plant operating problems. He has written many technical papers and articles.

• E. A. Nash has been elevated to the post of merchandising manager of Airtemp Div., Chrysler Corporation. Mr. Nash assumes the newly-created post after seven years as district and regional sales manager and sales training manager. J. G. Kehoe will replace Mr. Nash as sales training manager. Mr. Kehoe has held sales and personnel positions since joining the corporation in 1941. Recently he has been director of personnel training for the rangefinder production program since its beginning last year.

• Three new representatives are announced by Farr Co., Los Angeles, Calif. They are Johnson Filter Sales Co., Cleveland, Ohio; Pittsburgh Air Filter Service Co., Pittsburgh, Pa., and Air Filter Sales and Service-Detroit, Detroit, Mich. They will represent sales and service in their respective areas.

• The appointment of Donald C. Smith as manager of air conditioning sales was announced by The Crosley Div., Avco Mfg. Corp., Cincinnati, Ohio. Mr. Smith, who has had experience in the appliance field embracing retail, wholesale and manufacturing backgrounds, comes to the company from Williams and Shelton Co., Charlotte, N. C., where he served as general manager. His previous connections include Interstate Electric Co., New Orleans, La., where he served as sales manager. Mr. Smith succeeded Ted Nemes, who had resigned.

• J. W. Owens, national chairman of the Old Timers' Club of the Oil Burner Industry advises that the impromptu get-together of the Old Timers' during the week of the Heating and Ventilating Show, in Chicago, was pronounced a huge success by the many members present as well as the forty invited guests. This guest night was an innovation for the Old Timers', as it was the first time an outsider had a chance to have a look at the Old Timers' in action. Judging from the many membership applications requested, the guests were well pleased with what they observed. The next get-together will be the annual meeting for members only to be held April 20th—also at the Furniture Club of Chicago. This meeting is regularly held in conjunction with the convention of the Oil Heat Institute which will start in Chicago on that date.

• Illinois Engineering Co., Chicago, Ill., announces the retirement of James C. Matchett as president, and the re-election of Robert L. Gifford, a co-founder of the company, as president. Gordon L. Harris, vice president, has been elected general manager of the company.

• At the annual meeting of the Air Filter Institute in Chicago, a test code for rating panel type air filters was adopted. The Institute is preparing a standard form on which manufacturers of filters may submit performance reports. Officers of AFI are: President, W. B. Waterson, Air-Maze Corp.; 1st vice president, L. L. Dollinger, Jr., Dollinger Corp.; 2nd vice president, E. W. Meyers, Jr., Trion, Inc.; Secretary treasurer, J. R. McConnell, American Air Filters Co., Inc.; Trustee, W. W. Kuenn, Owens-Corning Fiberglas Corp.

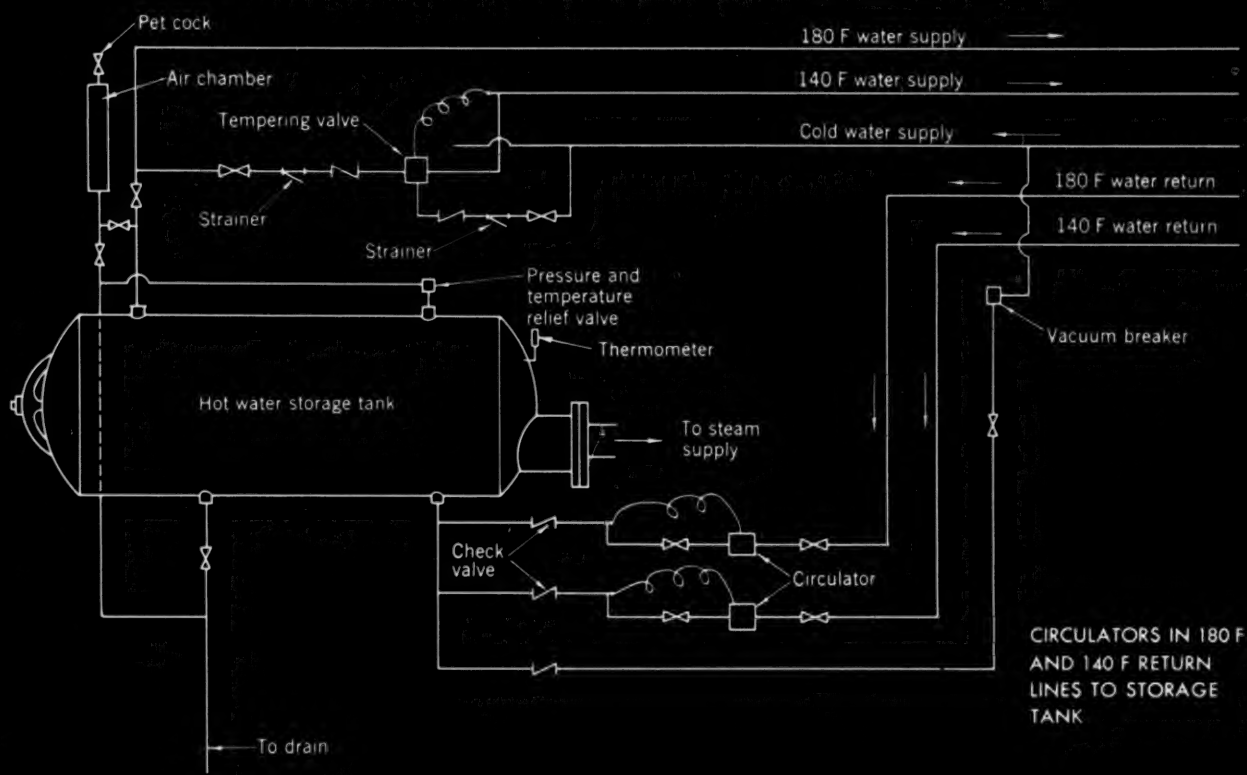
• Announcement was made by Iron Fireman Mfg. Co., Cleveland, Ohio, of the resignation of T. A. Marsh, industrial engineer and manager of direct sales. Mr. Marsh, who has been prominent in combustion engineering for many years, joined the organization in 1934. Much of his work prior to 1940 was on the design of pneumatic spreader stokers, and he has been granted a number of patents on fuel-burning equipment and accessories. Mr. Marsh plans to enter private practice in Cleveland as a consulting engineer in the combustion and smoke abatement fields.

• Norge Heat Div., Borg-Warner Corp., Kalamazoo, Mich., has announced the appointment of W. C. Walter as general sales manager. Mr. Walter has been associated with the division for more than six years, although he first joined the corporation in 1935 when he handled the sales of domestic heating equipment in New York City. In his new position he will direct the activities of the national sales program with regional sales representatives and will also have charge of the Canadian Export Division.

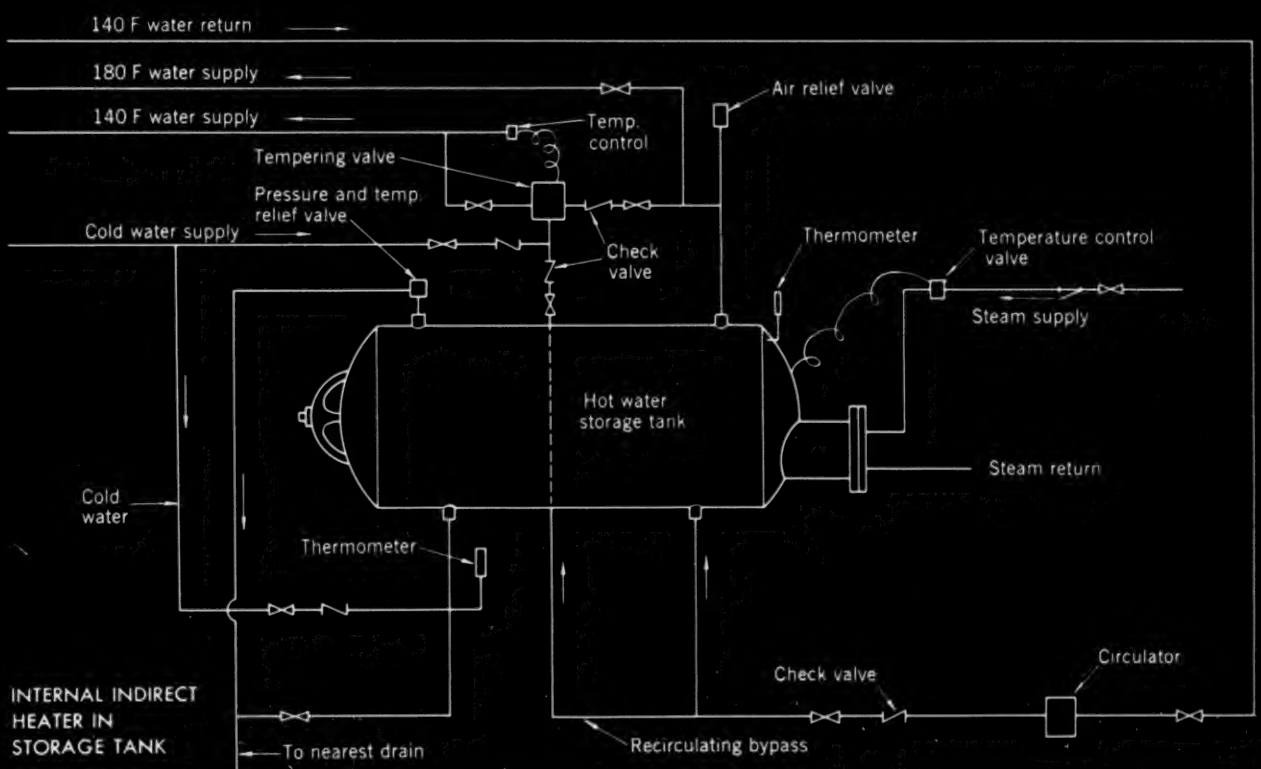
• Direct Mail Advertising Association announced the resignation of Frank Frazier as executive director and the appointment of William B. Henderson as managing director. Mr. Frazier plans to return to industrial advertising and sales promotion. Mr. Henderson was previously executive vice-president of Air Conditioning and Refrigerating Machinery Association for many years.

HEATING AND VENTILATING'S DETAIL SHEET

SERVICE HOT WATER PIPING
WITH WATER SUPPLY AT TWO TEMPERATURES



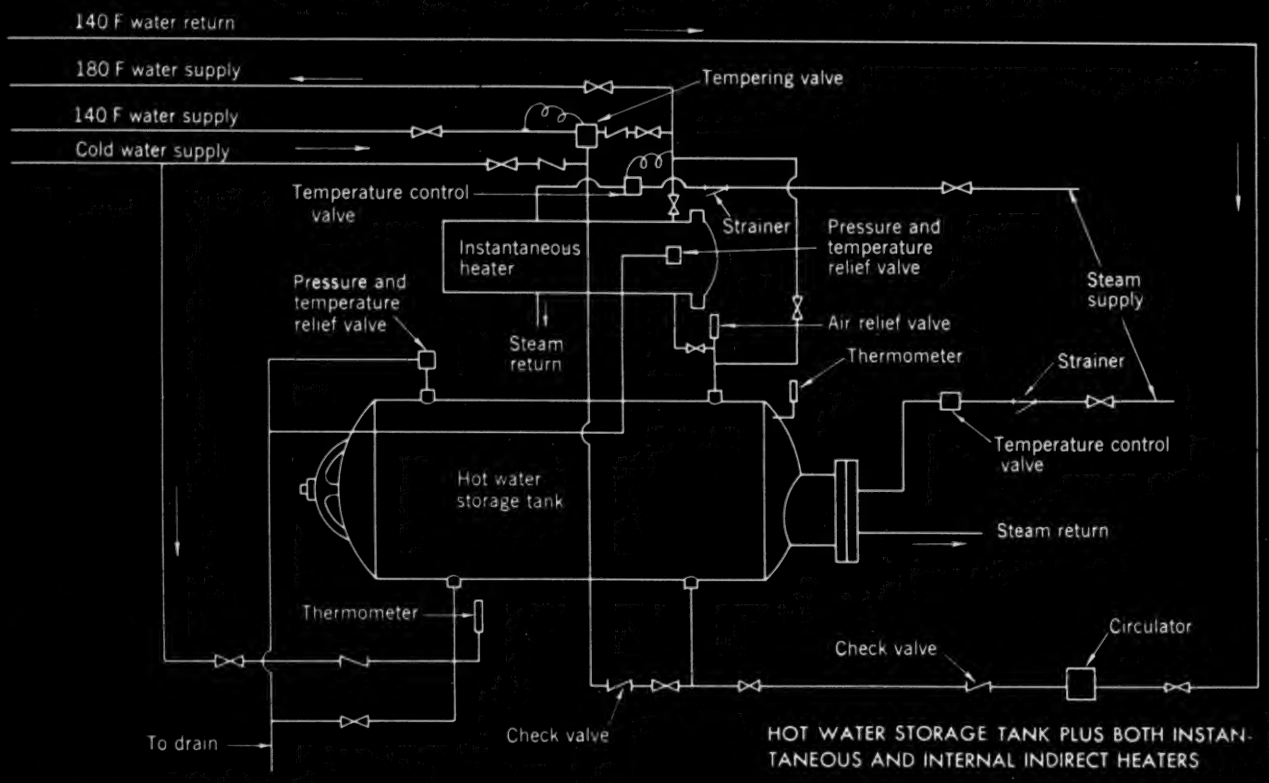
CIRCULATORS IN 180 F AND 140 F RETURN LINES TO STORAGE TANK



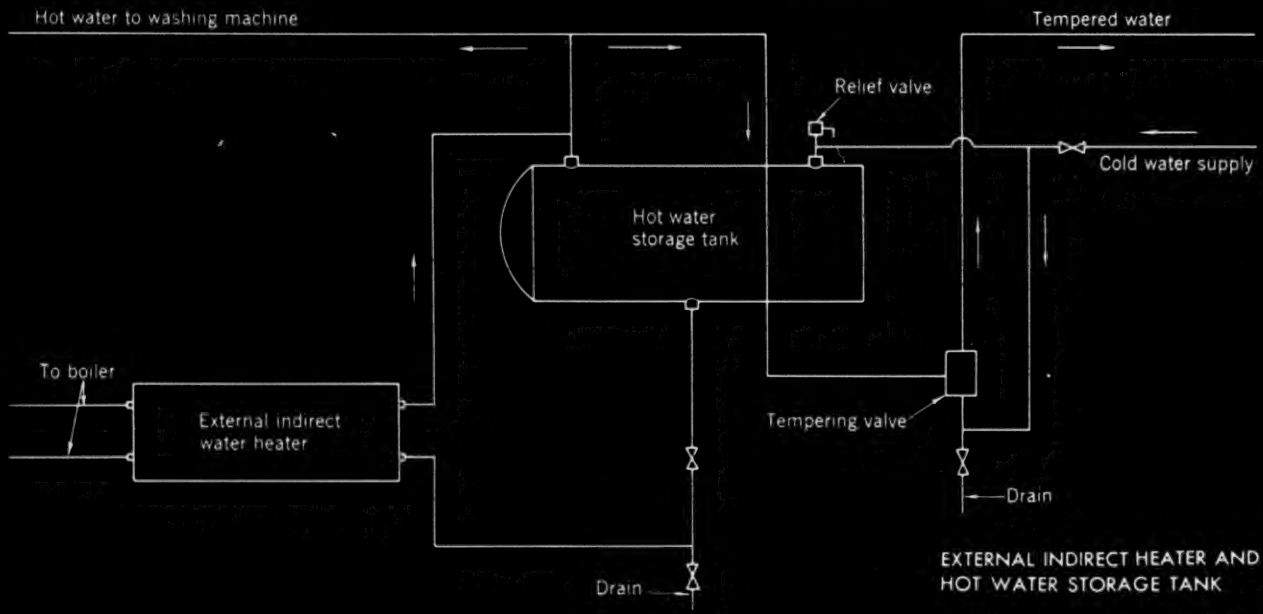
INTERNAL INDIRECT HEATER IN STORAGE TANK

HEATING AND VENTILATING'S DETAIL SHEET

SERVICE HOT WATER PIPING
WITH WATER SUPPLY AT TWO TEMPERATURES



HOT WATER STORAGE TANK PLUS BOTH INSTANTANEOUS AND INTERNAL INDIRECT HEATERS



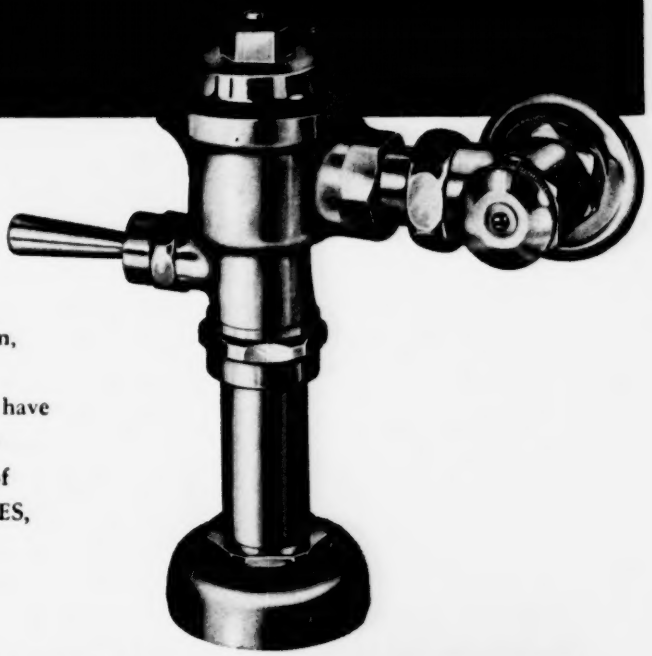
EXTERNAL INDIRECT HEATER AND HOT WATER STORAGE TANK

PIPING HOOOKUPS THROUGH THE COOPERATION OF ALBERT KAHN ASSOCIATED ARCHITECTS AND ENGINEERS, INC., DETROIT, MICH.; LOUIS BLENDERMANN, GLEN COVE, N. Y.; TACO HEATERS, INC., PROVIDENCE, R. I.

And in New York – A FUTURE OF FAULTLESS SERVICE

BEEKMAN-DOWNTOWN HOSPITAL
New York City
LORIMER & ROSE
architects
WILLIAM F. JEFFREY
project manager
ROBERTS & SCHAEFER COMPANY
structural engineers
KARSUNKY, WEEKS & GOOCH
mechanical engineers
JARCHO BROS., INC.
plumbing contractors
CRANE CO.
plumbing fixtures manufacturer and wholesale distributor

This superbly planned, modern structure —a current COYNE & DELANY installation —is the new home of the Beekman-Downtown Hospital. Providing emergency facilities for the financial district, and its dense daytime population, the Beekman's credo of service to the community will now be augmented. The architects and engineers have projected this concept of unfailing service into the details of design—including the specification of COYNE & DELANY diaphragm type FLUSH VALVES, with "Turn-to-Silence" equipment—a superior flush valve for an outstanding project.

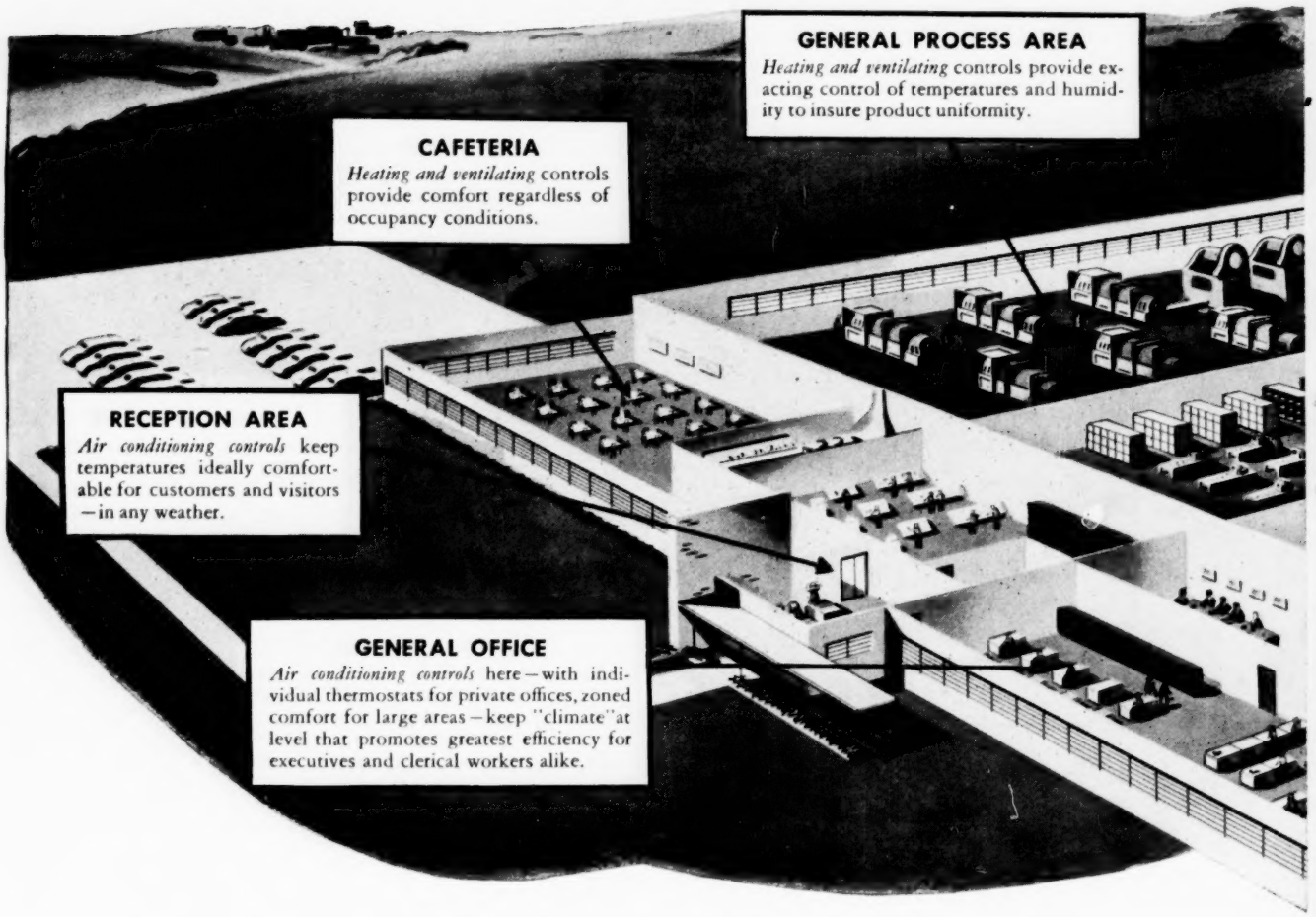


For those who have lived with COYNE & DELANY there is no other valve. Shown at left is a deciding factor—the interior working assembly of a DELANY valve. Only six working parts comprise this assembly—less than any other valve offers today. Removing the valve cover immediately identifies any source of difficulty, and replacements, if necessary, are accomplished inexpensively, instantaneously—and infrequently.

DELANY *Flush* VALVES Since 1879

COYNE & DELANY CO. • 834 KENT AVE. • BROOKLYN, NEW YORK

IN CANADA: THE JAMES ROBERTSON CO., LTD.


GENERAL PROCESS AREA
Heating and ventilating controls provide exacting control of temperatures and humidity to insure product uniformity.
CAFETERIA
Heating and ventilating controls provide comfort regardless of occupancy conditions.
RECEPTION AREA
Air conditioning controls keep temperatures ideally comfortable for customers and visitors —in any weather.
GENERAL OFFICE
Air conditioning controls here—with individual thermostats for private offices, zoned comfort for large areas—keep "climate" at level that promotes greatest efficiency for executives and clerical workers alike.

How Honeywell Customized Temperature Control Can Raise Industrial Efficiency

Take two of the most important factors in business today: employee work-output and product quality.

There's good evidence that on both counts the efficiency of a plant could be considerably improved by proper installation of Honeywell Controls.

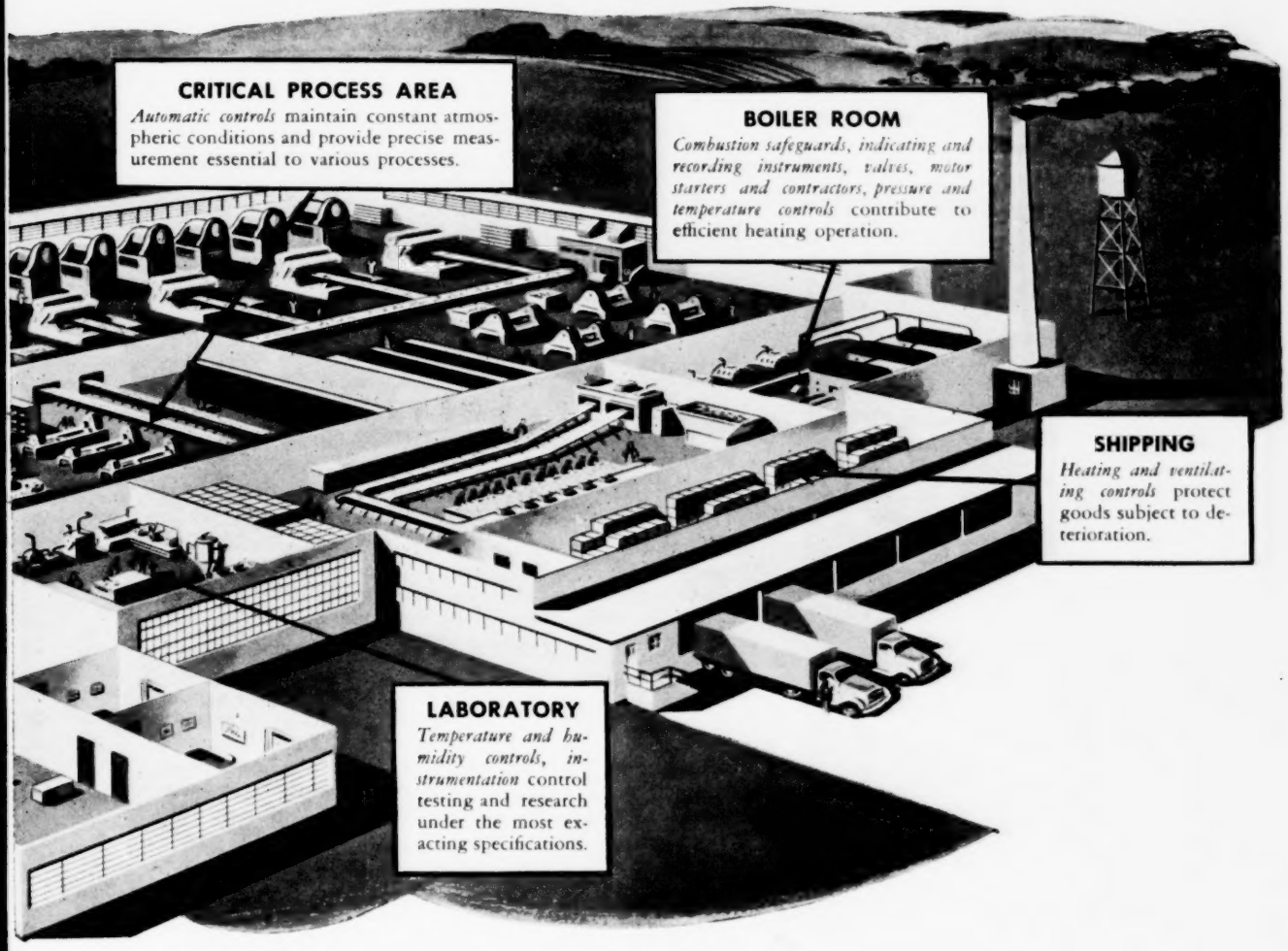
As for the amount of work employees do . . . scores of plants throughout the country have greatly boosted efficiency—by protecting workers' health, increasing their comfort, making them happier.

One of the primary ways this was done was through the use of Honeywell Customized Temperature Control installations in areas like those above. By compensating for such varying factors as weather, exposure, occupancy, internal heat sources and type of building construction, Honeywell Controls have greatly improved working conditions.

Or consider the realm of product quality . . .

Honeywell control installations in industrial centers have helped improve products, often have made possible a much greater degree of uniformity. These controls for temperature, humidity and process instrumentation are in daily use by industries as divergent as pickle packers and uranium processors, paper manufacturers and steel fabricators.

And in many cases, Honeywell Customized Control installations are saving businesses thousands of dollars yearly through more economical use of fuel.


CRITICAL PROCESS AREA
Automatic controls maintain constant atmospheric conditions and provide precise measurement essential to various processes.
BOILER ROOM
Combustion safeguards, indicating and recording instruments, valves, motor starters and contractors, pressure and temperature controls contribute to efficient heating operation.
SHIPPING
Heating and ventilating controls protect goods subject to deterioration.
LABORATORY
Temperature and humidity controls, instrumentation control testing and research under the most exacting specifications.

For Comfortable, Even Temperature in New or Existing Buildings—of any size—Use Honeywell Customized Temperature Control

Whether it's a factory, school, office, hospital, apartment, store, garage — or any size building — new or existing, Honeywell Customized Temperature Control can help meet your clients' heating, ventilating, air conditioning and industrial control problems.

Once equipped with Honeywell Customized Temperature Control, they'll have an ideal indoor "climate" — and save fuel besides.

And with a complete line of pneumatic, electric and electronic controls to choose from, Honeywell Customized Temperature Control offers you the greatest flexibility in design. Then, too, when it comes to performance, Honeywell-built controls assure years of trouble-free operation. And they're backed by the finest service organization in the controls industry.

For full facts on Honeywell Customized Temperature Control, call your local Honeywell office. There are 104 across the nation. Or mail the coupon today.

MINNEAPOLIS
Honeywell

First in Controls

MINNEAPOLIS-HONEYWELL REGULATOR CO.
Dept. HV-4-58, Minneapolis 8, Minnesota

Gentlemen:

I'm interested in learning more about Honeywell Customized Temperature Control.

Name .....

Firm Name .....

Address .....

City ..... *Zone* ..... *State* .....

Wagner
ELECTRIC MOTORS
...the choice of leaders in industry

Insure your sealed units against motor failure...

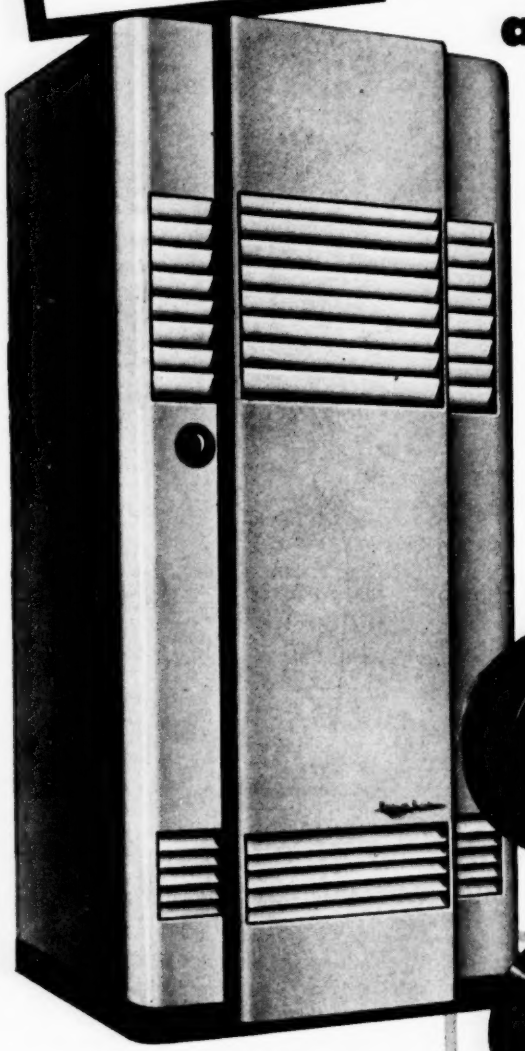
use

Wagner

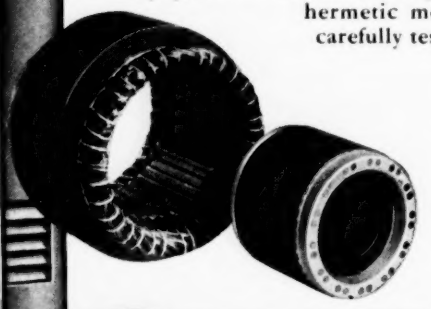
Hermetic Motors

Hermetically sealed compressors for air conditioners and refrigerating equipment are rapidly gaining preference because of the great convenience they offer to users of the equipment—there is nothing to oil or adjust, no belts to wear out.

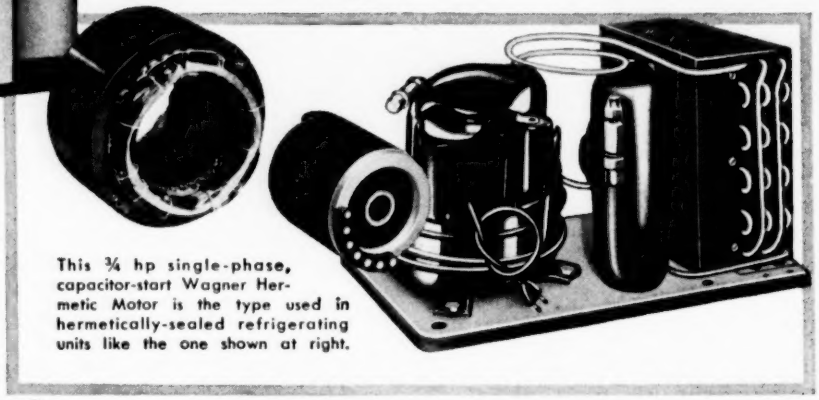
Wagner can provide hermetic motors to power *your* equipment. Wagner hermetic motors are available for both polyphase and single-phase applications. These hermetic motors, like all Wagner Motors, are backed by more than sixty years of motor building experience. Each Wagner hermetic motor is precision-built and carefully tested.



This compact, self-contained air conditioning unit, that may be located in or out of the air conditioned space, is typical of many such units powered by Wagner Hermetic Motors.



Wagner Hermetic Motor of the type used in self-contained air conditioners. This 7½ horsepower polyphase squirrel-cage motor is especially designed for use in sealed refrigeration units.



This ¾ hp single-phase, capacitor-start Wagner Hermetic Motor is the type used in hermetically-sealed refrigerating units like the one shown at right.

Consult a Wagner engineer on your motor applications. Call the nearest of our 32 branch offices, or write us for full information.

Wagner
Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6463 Plymouth Ave., St. Louis 14, Mo., U.S.A.

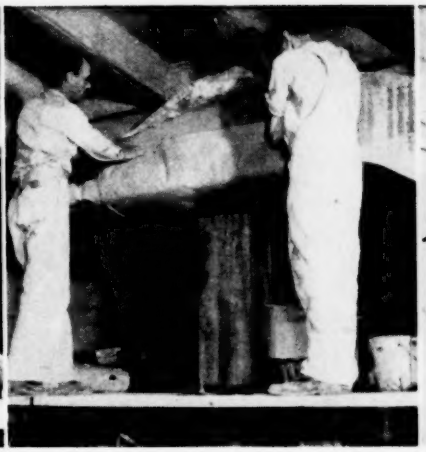
ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

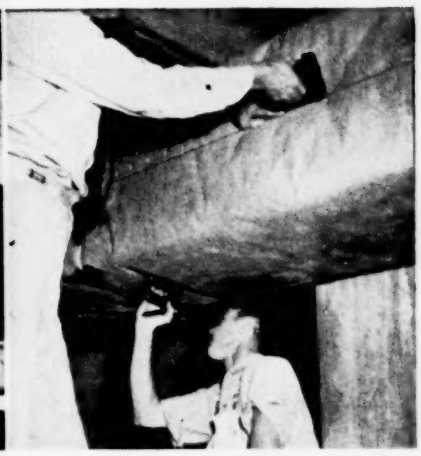
M53-5

New "Wrap-'n-Staple" method of insulating ducts with ULTRALITE

1 ULTRALITE glass fiber insulation, cut-to-size and already faced, hangs over duct. Spot daubing of adhesive helps hold ULTRALITE.



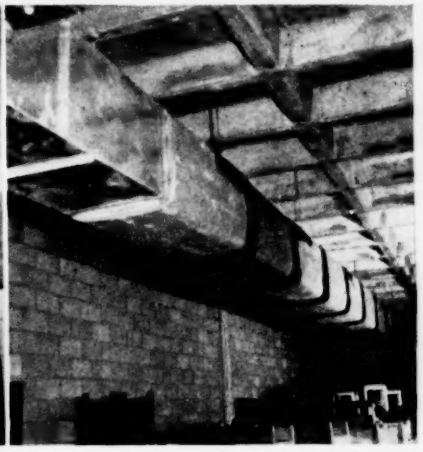
2 Wrapped around duct, ULTRALITE ends overlap. Insulation and vapor barrier facing are separated to form a 4" tab overlap to seal longitudinal joint.



3 Stapling gun converts loose tabs into secure longitudinal seam. Only ULTRALITE has the tensile strength that permits use of staples.*

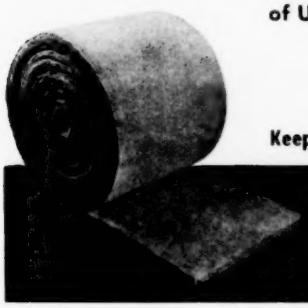
4 4" strips of standard asbestos furnace paper, painted with wheat paste, are applied over joints. Tapes that match facing are also available.

5 Stripped joints are painted with a coat of waterproof mastic to make certain that vapor condensation will never be a problem.



6 If concealed, duct can be left as-is. If appearance is important, duct can be finished off with muslin or painted with a water-based paint.

Call your ULTRALITE distributor, listed in the Yellow Pages, for details and delivery of ULTRALITE Duct Insulation (thermal) and ULTRALITE Duct Liner (acoustical) . . . today!



*The revolutionary new Bostitch T5-8 "outward clinching" staple gun clinches staples in mid-air. No need to have a clinching anvil or use the duct surface to bend the legs of the staple!

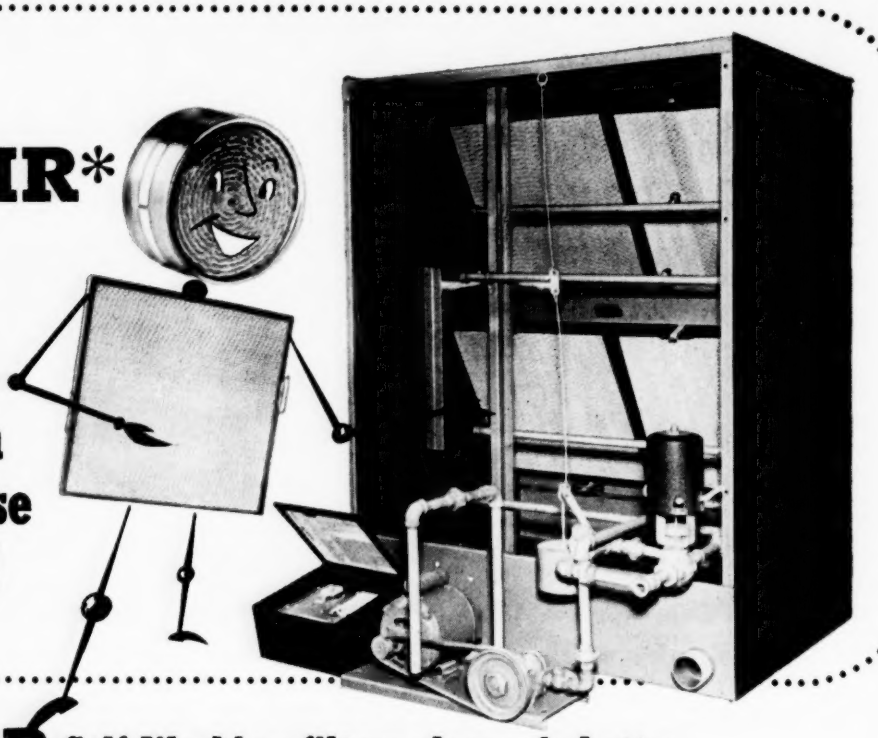
Keeping pace with the Nation's industrial requirements through research and development—since 1898

GUSTIN-BACON MANUFACTURING CO.

210 W. 10th St., Kansas City, Missouri

New York • Chicago • Philadelphia • San Francisco • Los Angeles
Houston • Tulsa • Fort Worth • Detroit

only FAR-AIR* gives you completely automatic air filtration with all these advantages!



FAR-AIR Self-Washing filters clean air better . . . provide these automatic features, too!

FAR-AIR Self-Washing filters give you more efficient, more dependable service. That's because FAR-AIR's exclusive herring-bone-crimp media design permits progressive loading and free air flow.

Find out today about completely *automatic* air filtration.

Washing, drying and oiling is controlled electrically on a pre-determined time schedule . . . *automatically!* Air cleaning efficiency remains constant. There is no liquid particle entrainment.

Water and dirt are flushed directly to sewer . . . *automatically!* There is no messy oil sump to collect sludge and create a fire hazard. Maintenance man-hours are reduced. Built-in controls guard against fire . . . *automatically!* These are Far-Air features:

No entrainment • No sludge—no oil sump
Automatic fire control • Minimum maintenance
Easy installation

FAR-AIR FILTERS

"Better by Farr"

*Trade Mark Reg.

FARR COMPANY

Manufacturing Engineers

CHICAGO · LOS ANGELES · NEW YORK

Mf'd under license by Control Equipment Co., Ltd. Montreal, Canada

MAIL COUPON NOW FOR COMPLETE INFORMATION!

Farr Company, P. O. Box 10187, Airport Station, Los Angeles 45, California

Please send me information on FAR-AIR Self-Washing filters.

I would ☐ would not ☐ like a Farr Field Engineer to discuss my air filtration problem with me.

Name _____ Title _____

Company _____

Address _____

Ready...

McDONNELL 202 SERIES T & P VALVE

Steam Rated on Pressure Side
Fully Automatic Reseating

HERE is the product so many contractors have been asking for. It's the new McDonnell 202 Series T & P Valve . . . or should we call it new? Actually it is new only in the sense that it brings together for the first time two fully tested, highly respected McDonnell relief valves. You can be sure that the 202 is the "happy combination" you've been needing because it combines two valves you know to be the best of their types!

Two fully-tested valves in one . . .

Yes, for pressure relief the 202 Series utilizes the operating mechanism of the McDonnell 230 series. This means that the pressure relief capacities (listed below) are *steam rated* in Btu's./per hr. in accordance with accepted procedure — the only way to match discharge capacity of a pressure relief valve to the Btu. output of a heater, thus precluding over-pressure under any and all emergency conditions. In fact, the 202 is the *only* T & P valve in which the pressure side is steam rated!

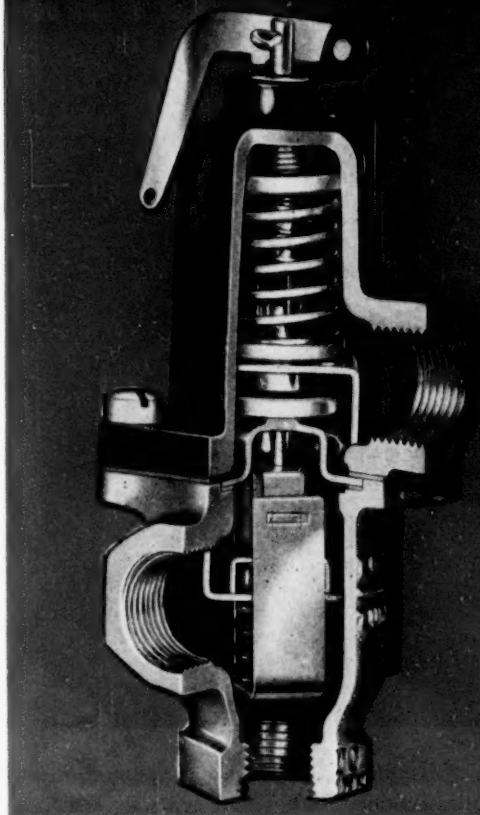
And for temperature relief the No. 202 embodies the operating mechanism of the No. 201 temperature relief valve . . . which means accurate response to temperature; powerful and positive opening; drip-tight reseating when temperature is under control. It means all this because the mechanism has the Vernatherm element which starts to open at precisely 188°F.; opens up to full capacity in a twenty degree rise; reseats tightly when temperature drops to 183°F.

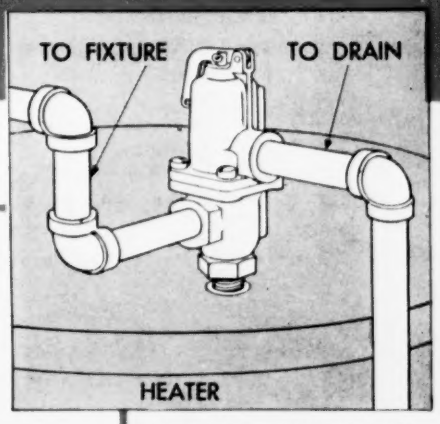
Also because the 202 series contains the 201 unit, it has the ¾" tapping for piping to fixtures which directs the service flow water through the body of the valve as diagrammed opposite. This is a real innovation. It cuts installation costs; it eliminates any air in the valve chamber; and, still more important, it keeps the temperature element subjected to service-water temperature, assuring control of the water temperature *as used*.

A new bulletin tells the whole story of the 202 series. Ask for it.

McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well





Note fixture tapping for taking service water through the body of the valve.

IT'S AS SIMPLE AS THIS

No. 230 Pressure Relief Valve	No. 201 Temperature Relief Valve	No. 202 T & P Relief Valve

You know what the 230 and 201 represent individually; so you know what they can do together in the 202!

Pressure relief capacities of the 202 series based on *steam discharge* are:

T & P Valve number	Opening pressure	Capacity Btu./hr.
202 - 75	75 lbs.	410,000
202 - 100	100 lbs.	527,000
202 - 125	125 lbs.	644,000

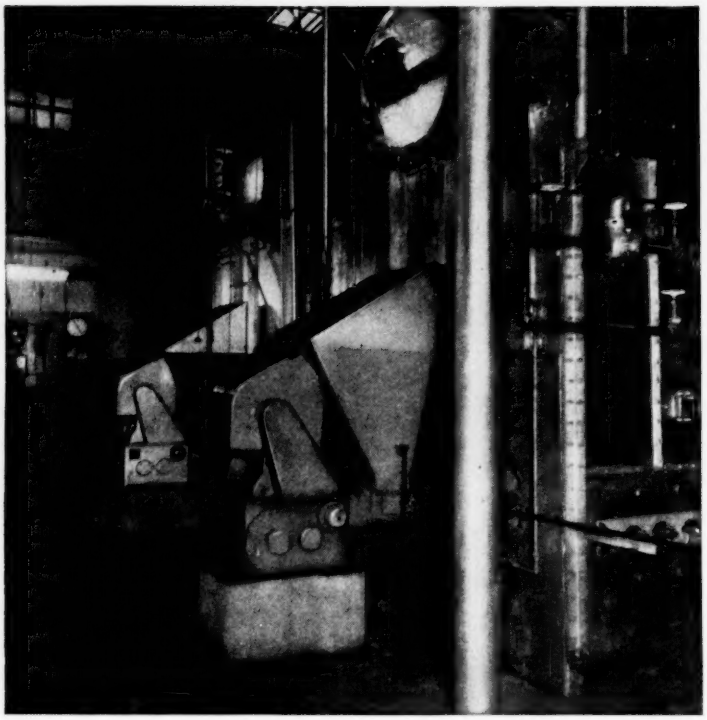
Temperature relief capacity of all No. 202 series T & P valves, based on hot water discharge, is 725,000 Btu./hr. (A G A tested and rated) Operating range of heating element: 188° — 208°F.

Your Jobber Stocks Them

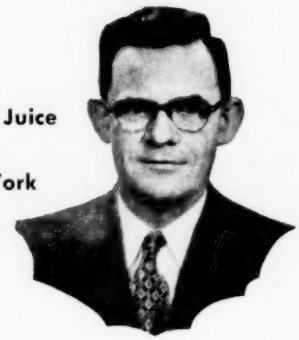
McDONNELL *Boiler Safety Devices*

"WE GET BIG SAVINGS BY BURNING COAL THE MODERN WAY!

Other fuels would cost us far more!"



says
Mr. A. J. Monta,
Plants Engineer,
The Welch Grape Juice
Company, Inc.,
Westfield, New York



"We analyzed the cost of coal and other fuels before modernizing our power plant. The result is this up-to-date coal installation that delivers steam at half the cost of competing fuels. *For economy you can't beat* bituminous *coal burned the modern way!*"

Modern coal-burning and handling equipment saves this plant more than 35% on labor alone! New stokers, boilers, controls and coal-handling equipment cut labor costs and save this plant 18% on fuel. The complete installation will pay for itself in about 6 years.

● Burning bituminous coal the modern way can save you money, too! Labor costs are cut to a minimum with up-to-date coal- and ash-handling equipment... modern combustion installations deliver anywhere from 10 to 40% more power from every ton of coal!

That's why, if you're planning to modernize or build a new plant, it will pay you to get the latest facts on coal. Let a consulting engineer show you how a modern coal installation designed to meet your specific needs can save you real money.

Here's something more! Today's bituminous coal customers get a better-prepared product—designed to meet their special requirements. And bituminous coal offers future dependability no other fuel can match. Reserves are virtually inexhaustible, and America's coal industry is the world's most efficient —your assurance of dependable supply of coal at relatively stable prices for years to come.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association, Washington, D. C.

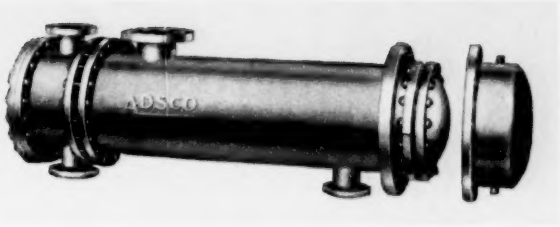
FOR HIGH EFFICIENCY ... FOR LOW COST

YOU CAN COUNT ON COAL!

ADSCO ENGINEERED

TO SOLVE ANY HEAT-EXCHANGER PROBLEM

Standard-design or tailor-made, ADSCO heat exchangers are engineered and manufactured to fit the exacting needs of ADSCO's industrial customers. Upon receiving a set of thermal conditions from a customer, ADSCO first applies its many years of experience to the design of the exchanger. And then into the manufacture goes all the know-how which ADSCO has acquired during its 75 years. The result is an exchanger which is not "almost right" but exactly right, a unit of the utmost efficiency... Investigate this specialized ADSCO service. You'll find it is low-cost, yet everywhere carries the ADSCO mark of quality which since 1877 has made ADSCO a leader.



A type of ADSCO heat exchanger widely used in industrial plants is the float-head, split-ring heat exchanger shown above. It is used for heating, cooling, or condensing, or for a combination of these. Shells can be of steel or a non-ferrous metal with either steel or non-ferrous tube sheets. Tubes of the removable tube bundle vary in size from 5/8" O. D. to 1¼" O. D. The pitch can be square or rectangular, depending on the fouling conditions and cleaning requirements. ADSCO heat exchangers are manufactured in conformity with ASME code for unfired pressure vessels.

ADSCO ENGINEERED PRODUCTS

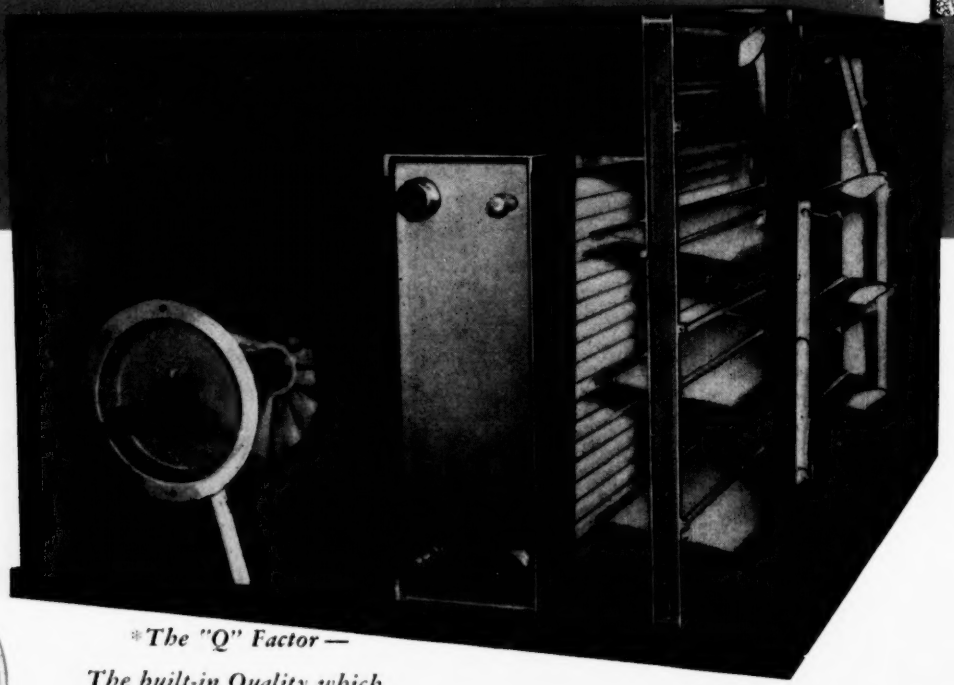
Expansion Joints . . . Separators . . . Meters . . . Steam Traps . . . Heat Exchangers . . . Strainers

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877

Why the contractor likes to install "Buffalo" P.C. Cabinets



DIAMOND JUBILEE 75TH ANNIVERSARY

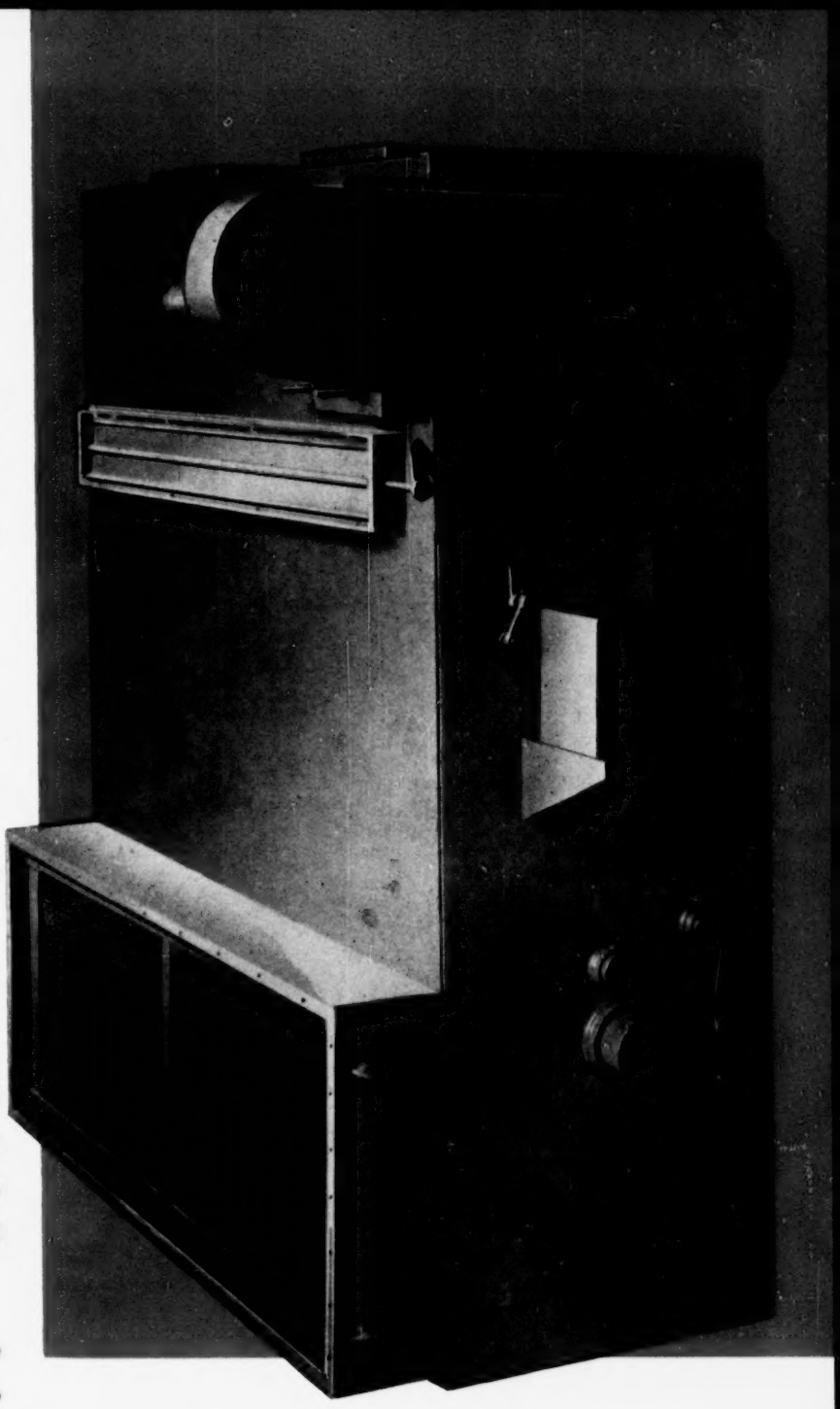
*The "Q" Factor —
*The built-in Quality which
provides trouble-free satisfaction and long life.*

WHEN "BUFFALO", more than twenty years ago, first offered sectionalized "PC" comfort conditioning cabinets, to industry and commerce, there was little competition.

Designed to provide a practical factory-made unit for year-'round air conditioning, these cabinets were quick to catch the favor of both users and contractors.

Today we have heating, cooling, cleaning, humidifying and de-humidifying or combinations of these functions in a die stamped sectionalized cabinet which (1) is easily knocked down to be moved thru normal building openings; (2) is assembled at low cost; (3) has quiet, mixed flow fans, mounted on oversized vibrationless hollow shafts; (4) has outside, easily lubricated bearings; (5) is adapted to quick economical insulations; (6) has Aerofin coils, the world's best; and (7) stays on the job.

No wonder the contractor likes to install "PC" Cabinets! And no wonder users like them. They have the "Q" Factor.* You can buy less for less, but not more for more!



"Buffalo" Sales Representatives are anxious to help you make the right selection.

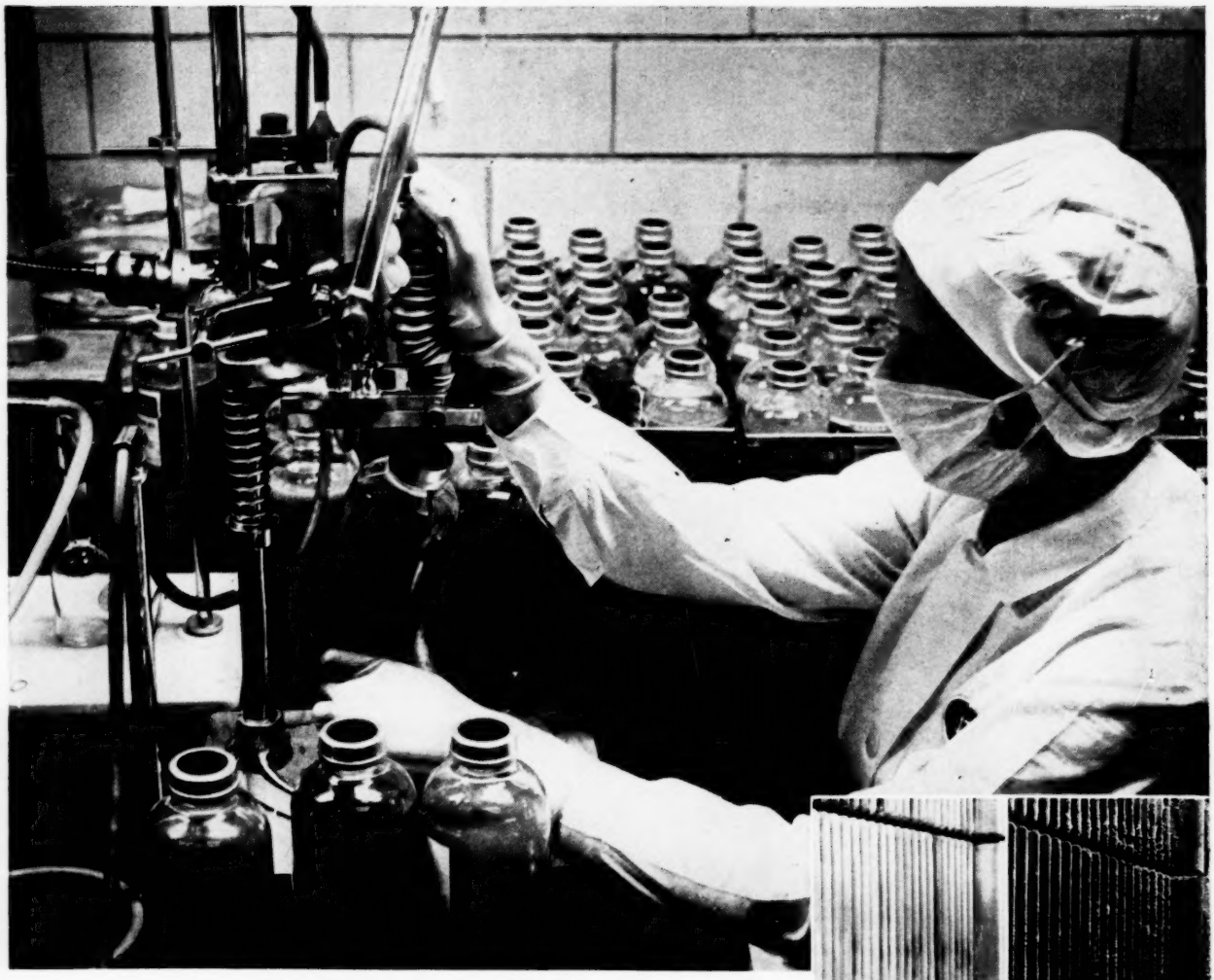
"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

480 BROADWAY BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities



Putting Air to work for Sharp & Dohme: Germ-free air is essential. Just "fresh air" won't do in the world's largest plasma plant.

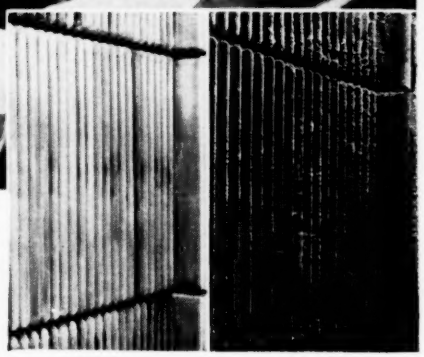
6000 MILES AWAY

PURE AIR FIGHTS BATTLE SHOCK

A wounded soldier's life depends on an early transfusion. But whole blood is perishable, and liquid plasma needs special storage. So dried plasma is used because it keeps its life-giving qualities for five years. That's why Sharp & Dohme's blood processing is so important—it accounts for over one third of today's output.

This operation is so delicate that just "fresh air" would contaminate precious plasma. To keep air at its highest purity, Sharp & Dohme uses Westinghouse PRECIPITRON®, the electronic air cleaner. Five PRECIPITRON units work 'round the clock to remove dirt and germs.

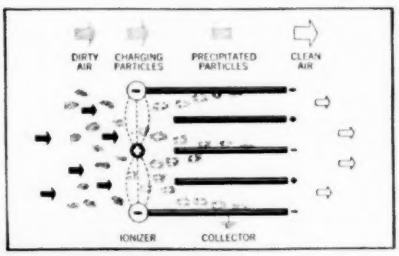
You can *put air to work*, too. Westinghouse has the equipment to handle it. For data on air cleaning, air handling or air conditioning products, ask for Catalog 600. Call your local Westinghouse-Sturtevant office. It's listed in the Yellow Pages. Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.



CLEAN PLATES DIRTY PLATES

Here's How PRECIPITRON Works—All dirt particles in the air stream are charged and attracted to collector plates of the opposite polarity. The above photos show how much dirt is collected in 2½ weeks of cleaning "fresh air".

The PRECIPITRON is the most efficient air cleaner available commercially for removing impurities from normal air.



WESTINGHOUSE AIR HANDLING

The Armed Forces need blood. *Give a pint today!*

YOU CAN BE SURE...IF IT'S Westinghouse

J-80291

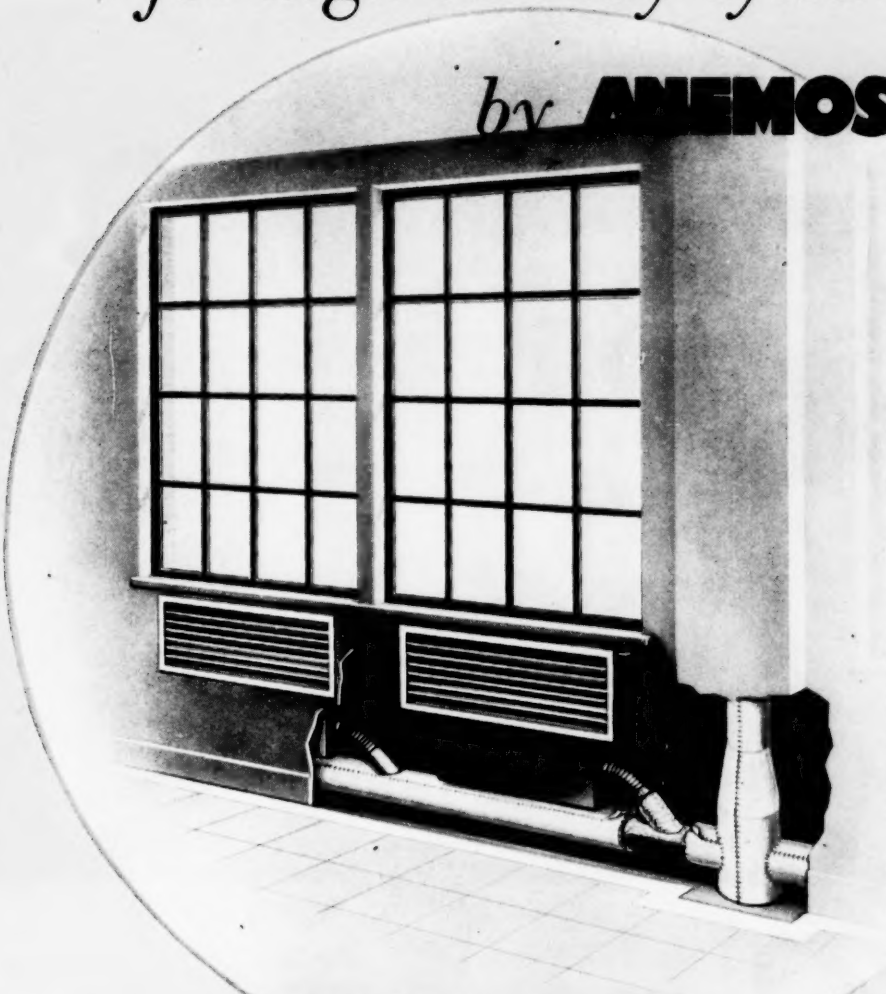
The New

UTW

UNDER THE WINDOW UNIT

for high velocity systems

by **ANEMOSTAT**



The Anemostat "ALL AIR" Under-the-Window Unit offers many new applications for high velocity air distribution. This unit requires no coils, drains, drip pans, or special thermostats and can be simply installed at low cost.

COOLING—Primary cooled air, having been mixed with induced room air, is propelled upward from the unit and further mixed with the warm air from the windows and exterior wall and is then draftlessly diffused throughout the occupied space. Controlled internal induction permits the use of temperature differentials up to 35°.

HEATING—By reducing the controlled induction, high temperature air is propelled upward from the unit and is mixed with the cold air from the windows. The temperature is thus equalized and the air is then draftlessly diffused throughout the occupied space.

ANEMOSTAT®

DRAFTLESS *Aspirating* **AIR DIFFUSERS**

ANEMOSTAT CORPORATION OF AMERICA

10 EAST 39th STREET, NEW YORK 16, N. Y.

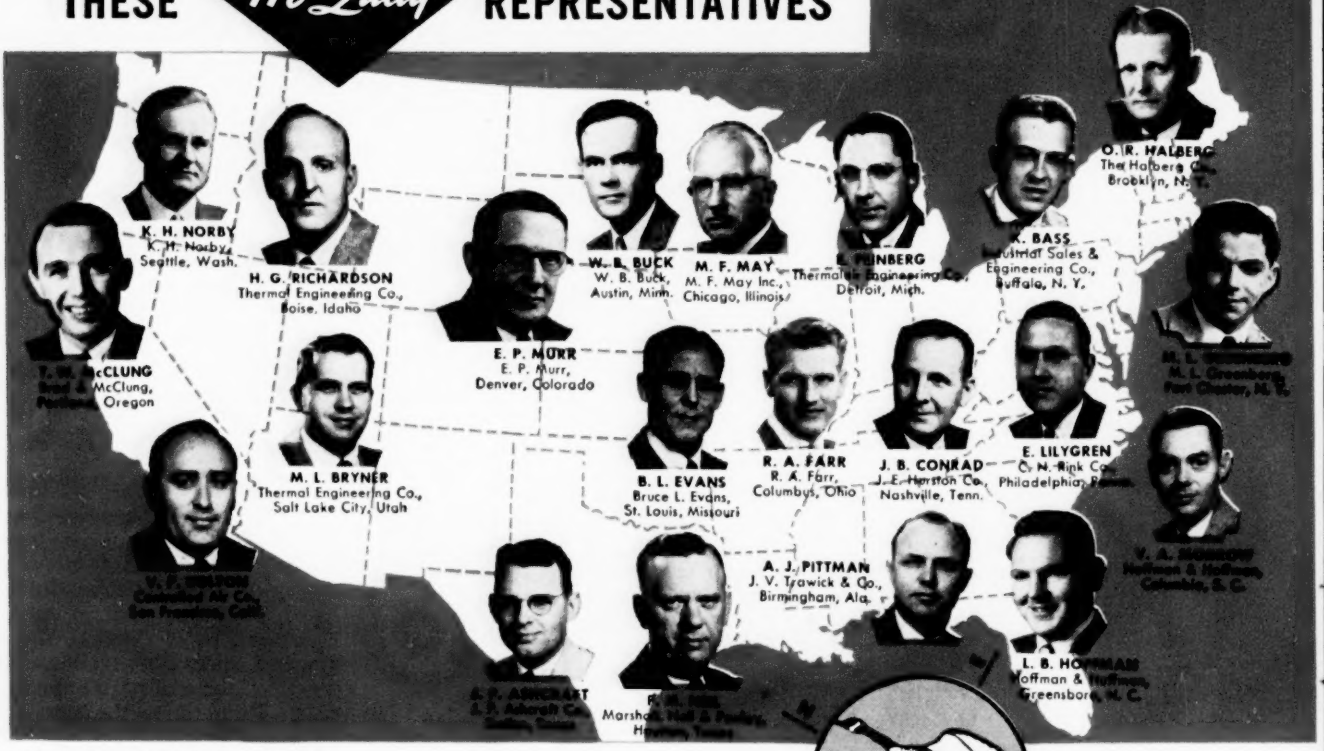
REPRESENTATIVES IN PRINCIPAL CITIES

"No Air Conditioning System Is Better Than Its Air Distribution"

AC 19

You can put full confidence in them!

THESE McQuay REPRESENTATIVES



No. 3 of a series of 3 advertisements.

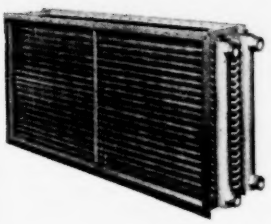
McQuay INC.

MAKE THE SEASONS COME TO YOU

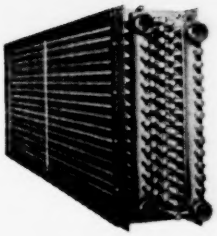
HEATING
REFRIGERATION
AIR CONDITIONING

1619 Broadway St. N. E., Minneapolis 13, Minnesota

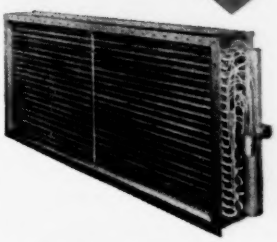
THIS COMPLETE LINE OF FAMOUS McQuay PRODUCTS



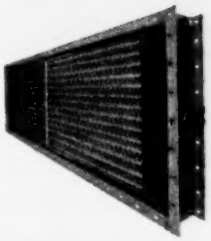
WATER COIL



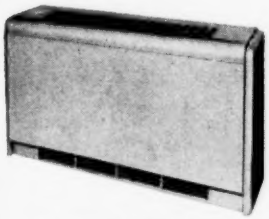
CLEANABLE TUBE WATER COIL



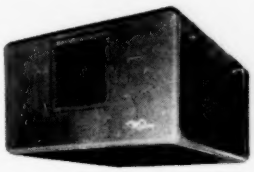
DIRECT EXPANSION COIL



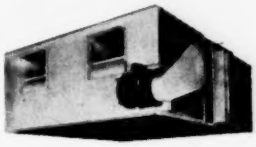
"BLAST" HEATING STEAM COIL



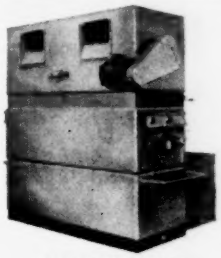
SEASONMAKER (FLOOR)



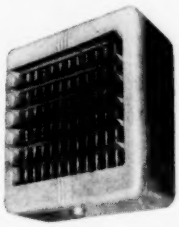
"RH" AIR CONDITIONER



AIR CONDITIONER
(Suspended Model)



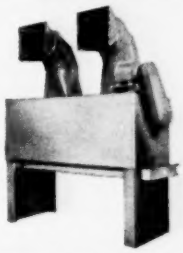
AIR CONDITIONER
(Floor Model)



HORIZONTAL UNIT HEATER

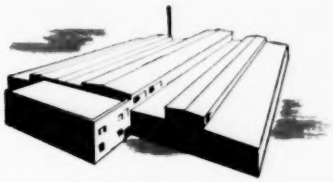
DOWN FLOW UNIT HEATER

BLOWER TYPE UNIT HEATER
(Suspended Model)

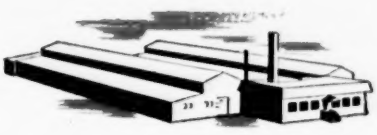


BLOWER TYPE UNIT HEATER
(Floor Model)

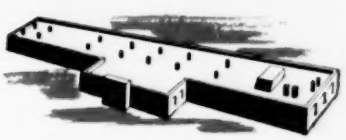
McQuay representatives, in all principal cities throughout the United States, are qualified by long experience and training to help you satisfy all of your air conditioning and heating requirements. For cooperation in making the sale, technical advice, or getting the job done on time, consult the McQuay representative in your territory. Available to you through him is the complete line of McQuay products, featuring famous Ripple-Fin construction—a McQuay exclusive, assuring maximum heat transfer efficiency and dependable performance.



PLANT 1—1600 Broadway N. E.
MINNEAPOLIS 13, MINN.

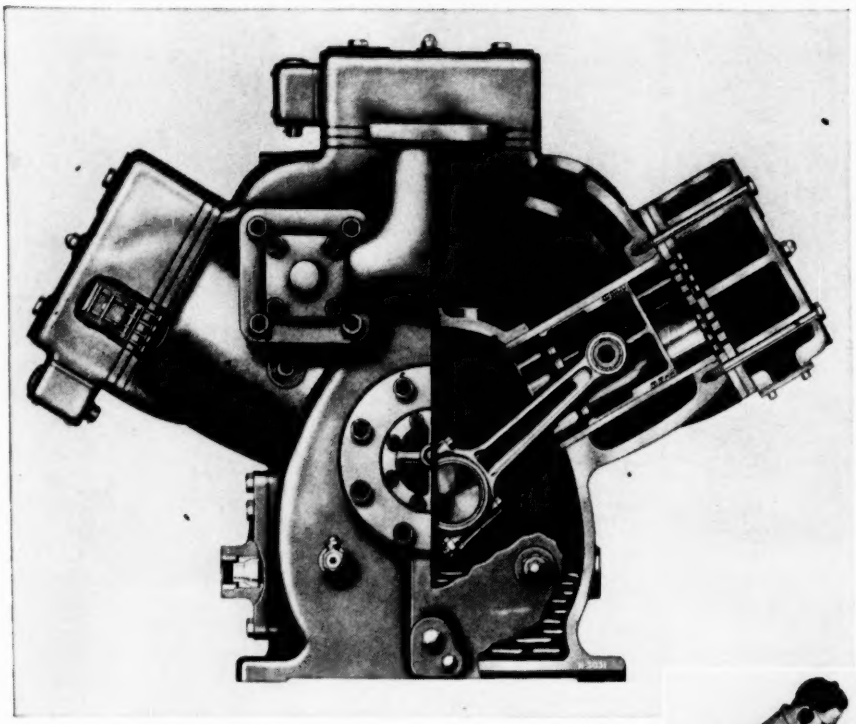


PLANT 2—1729 Broadway N. E.
MINNEAPOLIS 13, MINN.



PLANT 3—4th and Park Ave.
FARIBAULT, MINN.

Optimum-speed Freon compressor has high capacity plus long life!



New Worthington unit combines advantages of low and high speed

CUTAWAY VIEW of the new Worthington "J" compressor—the product of years of engineering research. Maximum capacity, with no loss in operating efficiency, is yours with this lighter-weight, optimum speed machine.

The problem was to design a compressor that would combine the advantages of *low*- and *high*-speed operation. Worthington's answer: the new, *optimum*-speed "J" compressor—a compact, high-capacity machine with the same high operating efficiency and life expectancy as its lower speed predecessors.

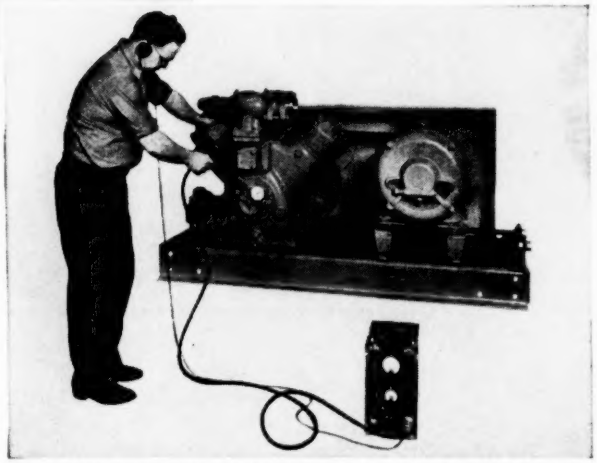
Here are just three of the many advancements in functional design that make the Worthington "J" line of compressors the finest available today.

1. ELECTRIC UNLOADING—a new achievement in variable capacity control. You can start compressor unloaded with a normal torque motor; power consumption is automatically balanced with load requirements. Separate unloader units in cylinder head allow easy maintenance . . . no complicated oil or gas pressure lines to worry about.

2. IMPROVED INTERNAL MANIFOLDING—cool suction gas completely surrounds the cylinder walls, providing longer valve life and increased overall efficiency. All passageways between suction discharge and shutoff valves are cast integrally within the crankcase, eliminating outboard fittings.

3. NEW FORCE-FEED LUBRICATION SYSTEM—full pressure, positive lubrication, regardless of rotation. A new rotary oil pump, driven directly by the crankshaft, eliminates complicated and noisy gear trains. Pump filters oil through a strainer in the crankcase.

Available in sizes of 3 to 150 tons, the new "J" compressors can be supplied with a horizontal shell and tube condenser, or they may be used with the Worthington Evaporative Condenser. Get in touch with your nearest Worthington district office, or write to Worthington Corporation, Air Conditioning and Refrigeration Division, Holyoke, Mass.



THIS ELECTRONIC LEAK DETECTION TEST is part of the rigid testing that every Worthington compressor goes through before leaving the factory. Pressure tests, underwater tests and vacuum tests make sure that every unit will give long, trouble-free service.

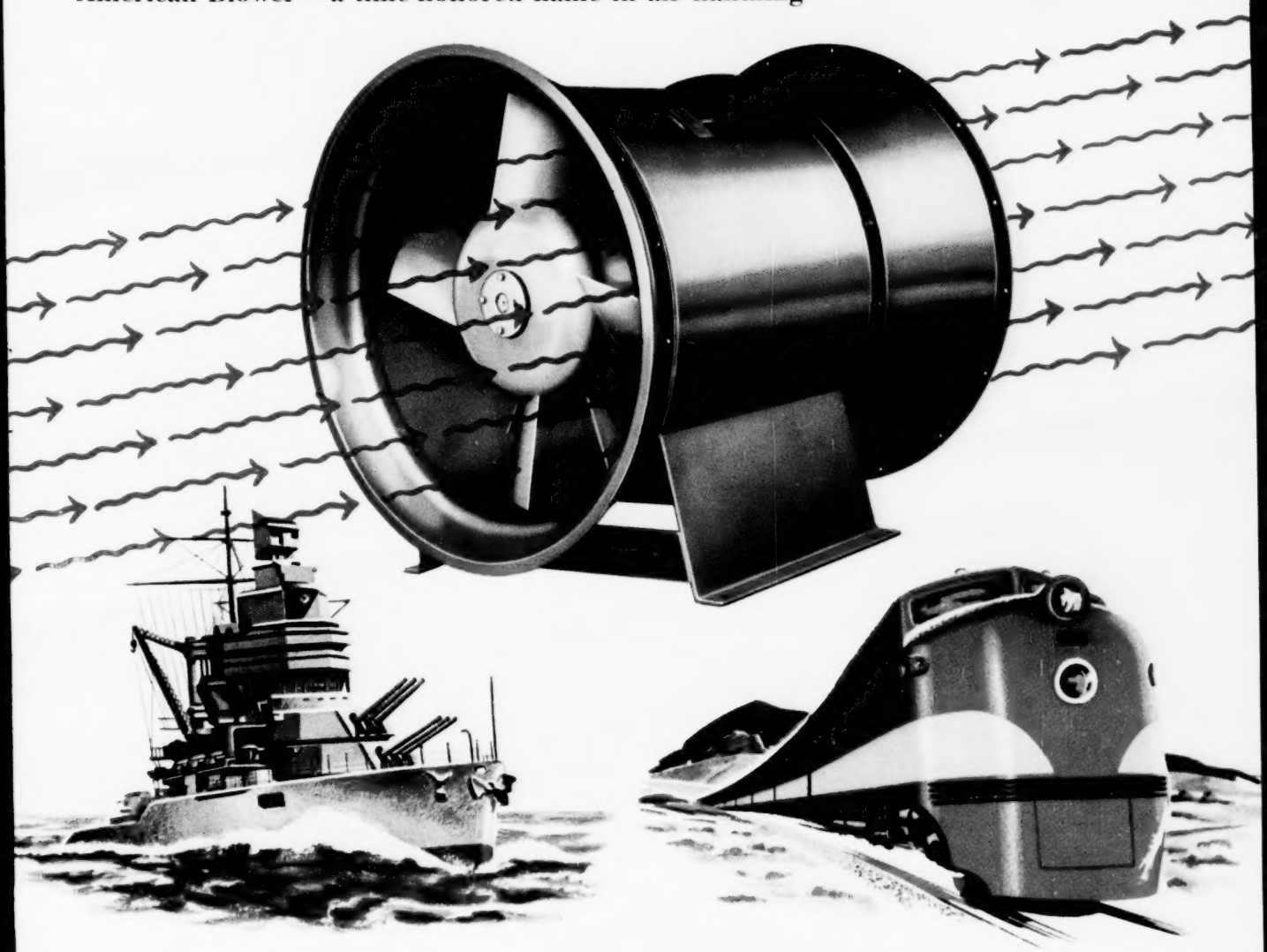
From the most complete line . . . comes the correct recommendation

WORTHINGTON

Air Conditioning and Refrigeration

A-3.3

American Blower – a time-honored name in air handling



Dependable, low cost ventilation!

The Navy demands it on battlewagons . . .

Railroads specify it for modern streamlined trains . . .

Commerce and industry require it for the conduct of profitable business . . .

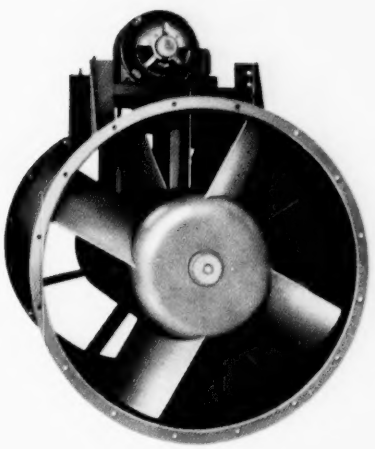
No one company has done more to provide dependable low cost ventilation than American Blower.

For example, American Blower Axial Fans are widely used in thousands upon thousands of varied applications, and are unsurpassed for ease of installation and efficient performance.

For complete information on axial fans and other American Blower Air Handling equipment, contact our nearest branch office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation



American Blower Axial Fans are smooth in performance, built for endurance and convenient to install.

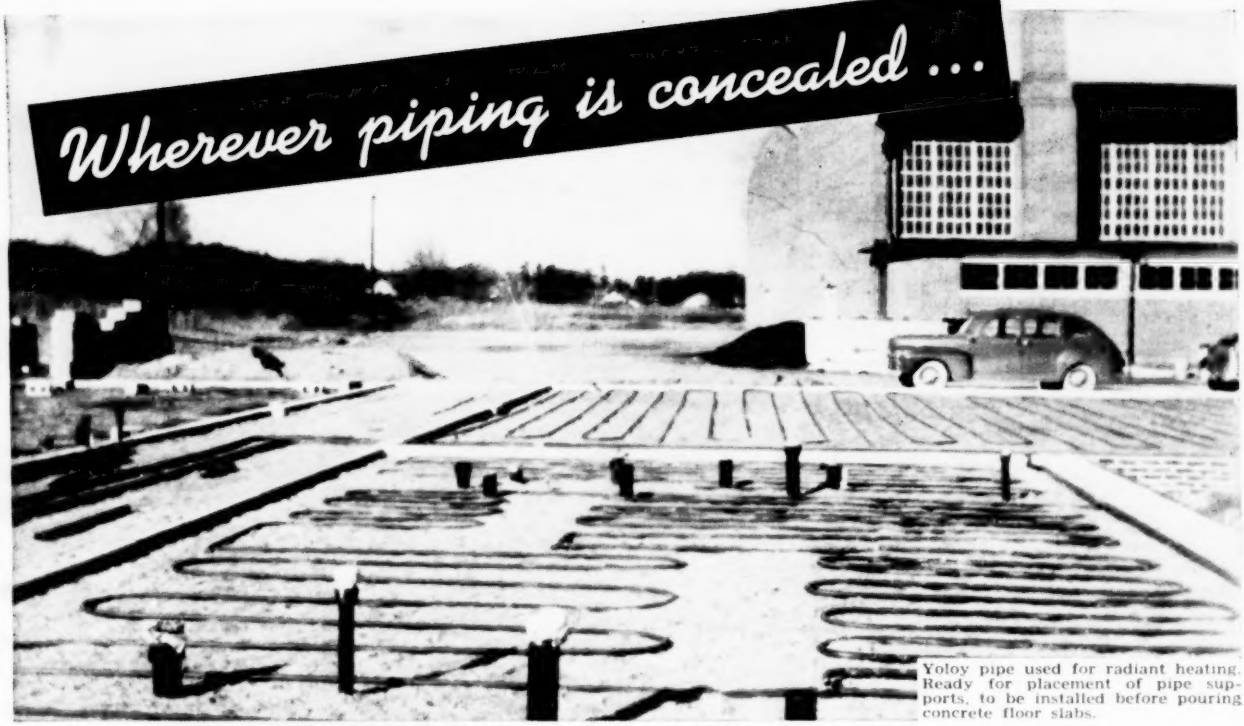
AMERICAN BLOWER

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

Wherever piping is concealed . . .



Yoloy pipe used for radiant heating. Ready for placement of pipe supports, to be installed before pouring concrete floor slabs.

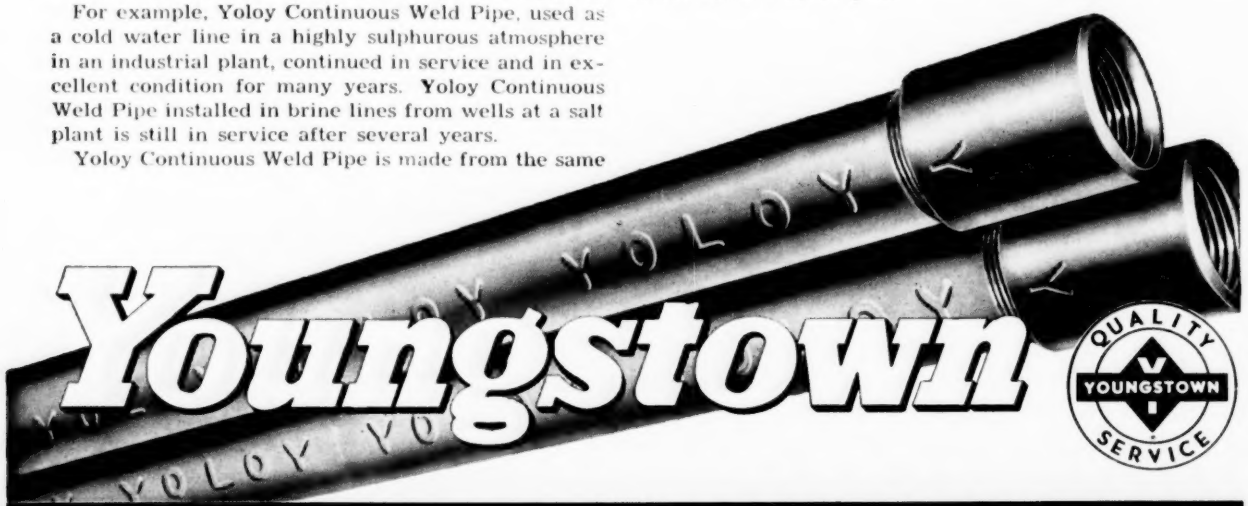
use YOLOY *continuous weld pipe*

Yoloy Continuous Weld Pipe offers distinct advantages for radiant heating and snow removal. Its use is recommended whenever piping is concealed—in industrial plants, commercial buildings, hospitals, schools and residences.

In standard tests Yoloy steel has demonstrated that its resistance to atmospheric corrosion is four to six times greater than that of regular steels. In actual installations Yoloy Pipe has demonstrated that it has a high resistance to many other corrosive conditions.

For example, Yoloy Continuous Weld Pipe, used as a cold water line in a highly sulphurous atmosphere in an industrial plant, continued in service and in excellent condition for many years. Yoloy Continuous Weld Pipe installed in brine lines from wells at a salt plant is still in service after several years.

Yoloy Continuous Weld Pipe is made from the same nickel-copper steel composition that has proved so successful in service in the oil, mining, railroad, chemical, trucking and other industries where resistance to corrosion and abrasion is of prime importance. This pipe is easy to thread and fabricate with standard pipe tools. It can be electric or gas welded readily. It has high strength and high resistance to abrasion, shock and vibration fatigue. For further information, write or phone the Youngstown District Sales Office nearest you.



Youngstown

QUALITY YOUNGSTOWN SERVICE

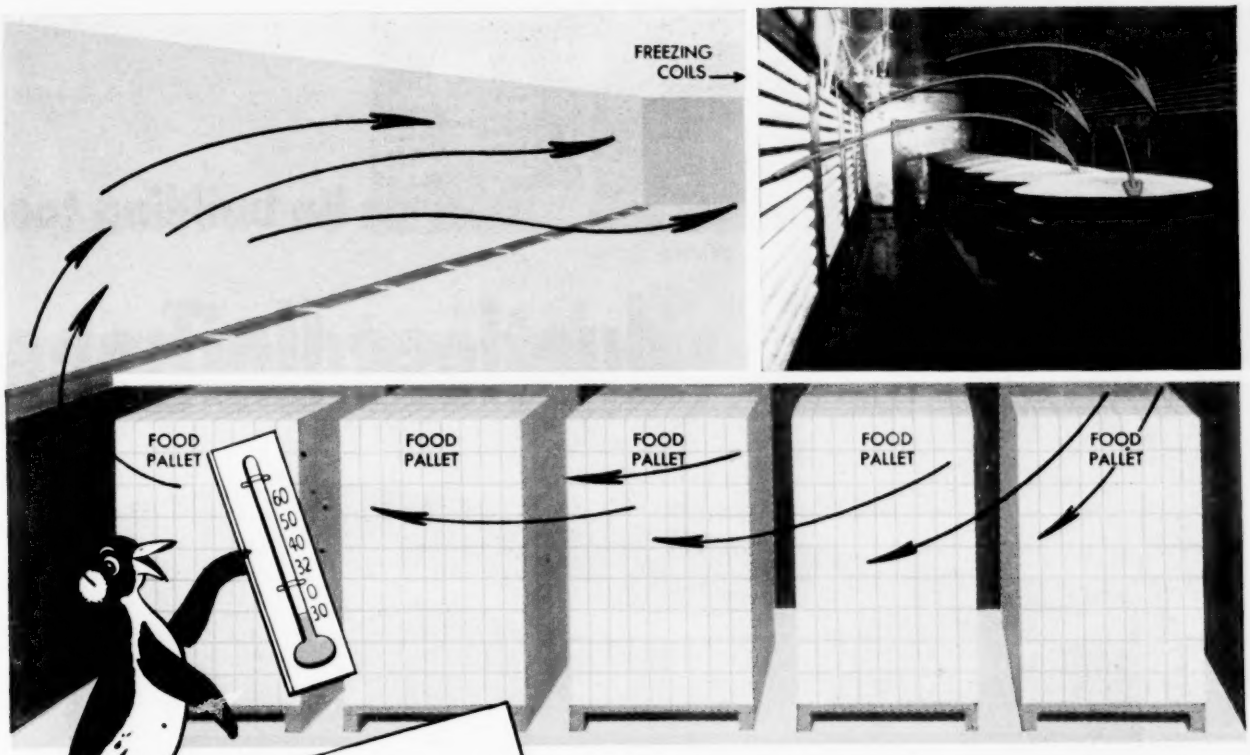
THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices — Youngstown 1, Ohio

Export Office - 500 Fifth Avenue, New York

COLD FINISHED CARBON AND ALLOY BARS - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS - PLATES - BARS - RAILROAD TRACK SPIKES.



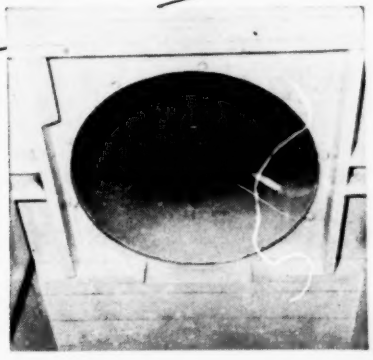
JOY AXIVANE® FANS HANDLE SEVERE QUICK-FREEZE JOB

A West Coast quick-freezing plant boasts an effective operation that utilizes 24 Joy 7½ HP Series 1000 Axivane Fans, installed in two groups of 12 each.

Note the illustration above. The upper floor contains freezing coils and a row of 12 fans. The floor below is partitioned into narrow freezing tunnels, each served independently by a single Joy fan.

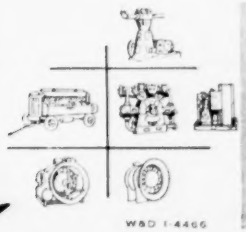
As air passes through the freezing coils, it is cooled to between —30° and —35°. This sub-zero air is propelled down and through the tunnels below, which contain pallets of meat, vegetables, fruit, etc. to be quick-frozen. After passing over the food, the air is again cooled and circulated. At full plant load, each 12-fan battery handles 242,000 CFM of air.

The relatively quiet operation, light weight, compactness and low power consumption of Joy Axivane Fans—due to the unmatched efficiency of their vaneaxial design—have proved *real* advantages on this job. Their in-line construction also saves space, since each fan can be mounted right in its short, vertical duct. In addition, extreme flexibility of operation is made possible by the adjustable blades, a standard Joy feature. ● Let us help you to get best results on your fan problems. ***Joy Manufacturing Company, Oliver Bldg., Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



Left: Looking up from the quick-freeze room below a Joy Axivane Fan. Note the compact, economical use of space and the simple mounting.

Consult a Joy Engineer

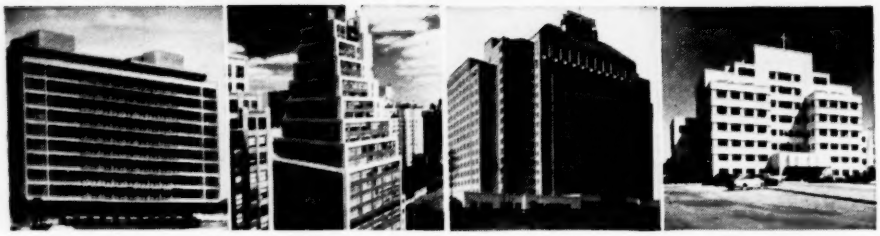


W&D 1-4466

for Vaneaxial Fans . . . Compressors, Vacuum Pumps and Boosters . . . Oxygen Generators

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885



Apartments *Offices* *Hotels* *Hospitals*

No building too

ductless UniTrane

ACCURATELY RATED AND TESTED

Every UniTrane unit is carefully designed, manufactured and tested to conform with published TRANE capacity ratings. Units require no maintenance other than semi-annual check-ups of oil cups and filters. Sturdy, die-formed steel cabinets are designed to withstand years of service.

for individual room control of

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR

large...few too small for

room-controlled air conditioning

Provides advantages of central system plus best features of the unit system!

It's different! The UniTrane System of air conditioning offers advantages of a central system PLUS quiet, compressor-free room units that cool or heat, dehumidify, ventilate, filter and circulate the air . . . and all this without the use of central system ducts!

Each tenant is boss—Because UniTrane provides individual room control, it meets widely varied demands in large office buildings, hospitals, hotels and commercial buildings down to small apartments and motels. Each tenant sets the temperature and ventilation of his room just as *he* wants it, without affecting any other room.

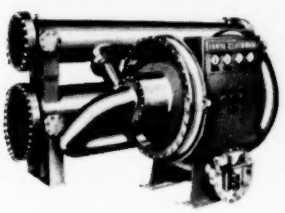
Big space saver—UniTrane saves space in many ways. Its single piping circuit handles chilled water in summer, hot water in winter. Ventilation air is introduced directly through the wall into the individual room units. The compact room units are only 25-inches high . . . can be recessed under windows. Large equipment rooms and accompanying ductwork are eliminated.

Accurate design data—Designing a UniTrane System is essentially a matter of selecting accurately rated units for the various rooms and zones. No multi-room buildings are too large to permit UniTrane air conditioning in each individual room.

Simple and flexible—UniTrane is nearly as simple to install and operate as is a standard heating system. It can easily be extended to new building additions. You can shift units or add units to meet changing requirements. You can install UniTranes for heating only and add central water chilling equipment later. You can shut off rooms and sections not being used. Even partially finished or partially occupied buildings can have complete room-controlled air conditioning with UniTrane.

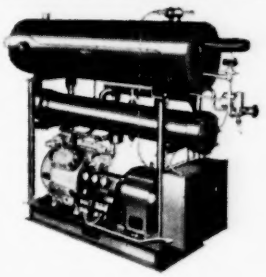
For complete information, contact your Trane Sales Office or write The Trane Company, LaCrosse, Wisconsin, for Bulletin DS 420.

For over 50-room UniTrane installations . . .



CENTRAVAC A complete centrifugal water chilling system, hermetically sealed. Five models from 45 to 200 tons. Automatic throttling controls permit efficient operation down to 10% capacity. Power consumption closely proportionate to load through entire range.

For 10 to 50-room UniTrane installations . . .



COLD-GENERATOR This unit delivers chilled water from one compact package . . . brings you a complete refrigeration cycle, factory engineered, factory assembled, factory tested, factory guaranteed! Only simple plumbing and electrical connections needed to install.

TEMPERATURE
HUMIDITY
VENTILATION

TRANE UniTrane

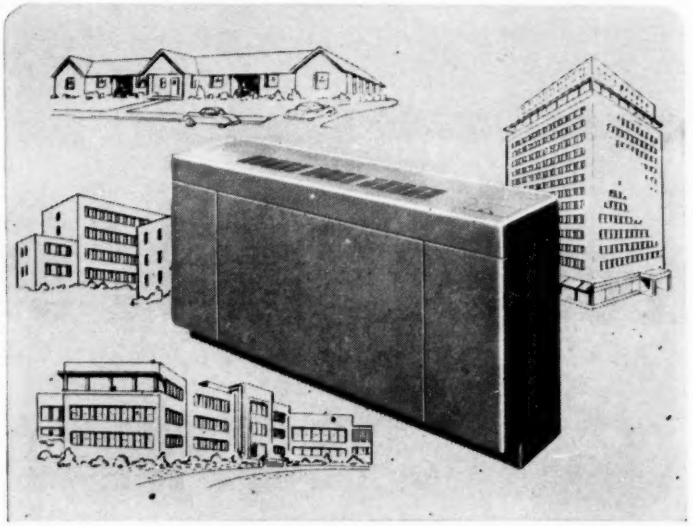
CONDITIONING EQUIPMENT The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto • 87 U.S. and 14 Canadian Offices

Here's the answer to simple, efficient, economical year 'round air conditioning

The REMOTAIRE
by AMERICAN-Standard

a new remote type unit for multi-room installations

Heats in Winter
Cools in Summer

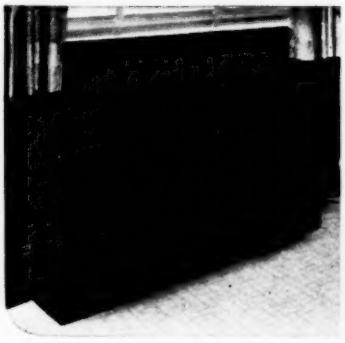


For hotels, motels, apartments, hospitals, offices and industrial buildings and other types of installations.

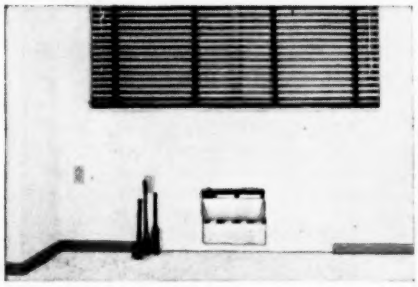
■ The Remotaire is an individual room remote type unit for providing year 'round air conditioning for central plant multi-room installations.

The Remotaire, as part of a Remotaire system, uses chilled water from a central water chiller for cooling and hot water from a central heating plant for heating. Individual control of each unit allows the occupant to choose the room temperature that suits him best without affecting adjoining spaces.

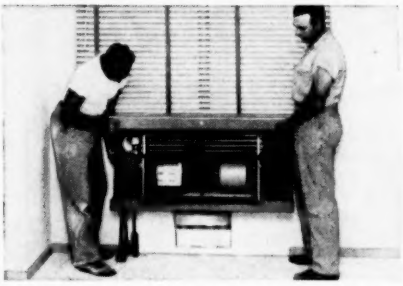
The Remotaire is enclosed in an attractive cabinet of sturdy, reinforced steel—plus a reinforced air grille—which adds to permanence and long-lasting beauty of unit. Designed for location under windows, this unit can be free standing or recessed into wall four inches.



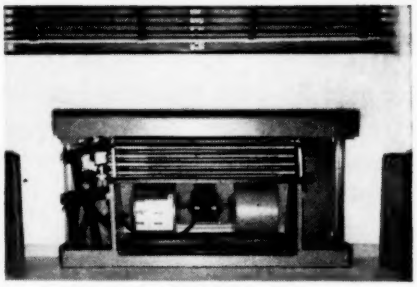
The REMOTAIRE Wall Aperture System is ideal for New Construction



LOCATION READY for Remotaire shows wall aperture, water supply, return, and condensate pipe stubs, and wall plug for electrical connections.



REMOTAIRE is set in place and leveled. Piping and electrical connections are made and pipe insulation applied.



HERE IS THE REMOTAIRE (with panels removed) showing the piping and electrical connections and pipe insulation completed.

As shown in the pictures above, the Remotaire, as part of a Remotaire Wall Aperture System, can be readily installed in the average building since piping connections are the principal installation requirement. Ventilation air is introduced through a small wall aperture behind each unit thus eliminating use of large, expensive, space-consuming ductwork. Other Remotaire systems, using other methods of ventilation, are ideal for modernization as well as new construction. Write for Remotaire Brochure, Form 298.

American Radiator & Standard Sanitary Corporation
P. O. Box 1226, Pittsburgh 30, Pennsylvania

AMERICAN-Standard
HEATING-COOLING

Serving home and industry:

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS & WALL TILE
DETROIT CONTROLS · KEWANEE BOILERS · ROSS EXCHANGERS

For a refreshing shower with crystal-clear water and full-pressure... your home should have hot and cold water lines of Chase Copper Water Tube and Fittings.

Chase Copper Water Tube delivers a full flow of water. It can't clog with rust... it resists corrosion. Whether you're building a new home or replacing old pipe, use durable copper. For long life, at low cost, it's a far better buy than rustable pipe.

Ask your architect, builder or plumbing contractor about Chase Copper Water Tube. It's available through Chase plumbing and heating wholesalers served by 23 Chase warehouses across the nation. Chase Brass & Copper Co., Incorporated, Waterbury 20, Conn.

Chase

The Nation's Headquarters for
BRASS & COPPER
subsidiary of
KENNECOTT COPPER CORPORATION

YOUR CUSTOMERS KNOW THAT CHASE MEANS QUALITY

When you install Chase Copper Water Tube, this ad gives you a sales plus. It tells the Chase quality story to 15,872,000 readers in the Saturday Evening Post and other leading consumer magazines.

CHASE BRASS & COPPER CO., WATERBURY 20, CONN., Warehouses and Sales Offices at: — Albany† Atlanta Baltimore Boston Chicago Cincinnati Cleveland Dallas Denver† Detroit Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester† St. Louis San Francisco Seattle Waterbury (†sales office only)

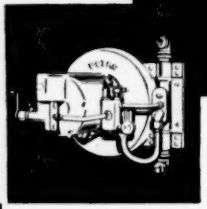
avoid trouble and complaints

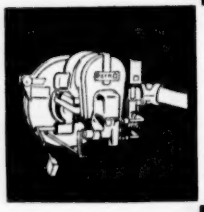
Petro OIL BURNERS

Specialists in oil heating for 50 years

Industrial Oil Burners

Rotary type. Burn low-cost, heavy fuel oil with complete reliability. Models for every industrial need. Capacities up to 200 gallons per hour.



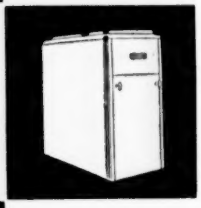


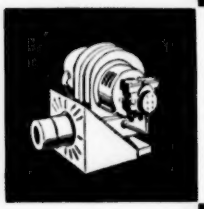
Combination Oil-Gas Burner

This commercial industrial burner is the answer to seasonal fuel shortages. Makes possible advantages in economical fuel buying.

Residential Furnaces and Boilers

Made in popular sizes to fit the heating needs of homes from 4 to 10 rooms. Extremely compact and attractive. Real fuel savers.



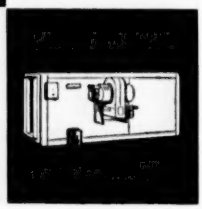


Conversion Units

Efficient, trouble-free oil burners for home and commercial use. Capacities up to 20 gallons per hour.

Horizontal Furnace

Hang it or hide it—this winter air conditioner fits anywhere. Available in five models from 80,000 to 180,000 Btu's (output at bonnet).



Complete Line

There's a size and type of Petro oil burner, or home furnace or boiler, to fit every oil firing need. The name Petro, since 1903, has been known and respected wherever oil burning equipment is used.

Simple, Dependable Operation

Petro oil burners cost the plant operator or homeowner less to own and operate because their performance is proved and simple. The fine reputation Petro equipment enjoys, and its popularity with owners, is the result of this simplicity and traditional dependability.

Easily Installed

Petro oil burners are compact and well built. Heavy mounting flanges, protected wire connections, easy access to oil and ignition lines, are all features which help make Petro oil burners the favorite of contractors and dealers all over the nation. They save installation time —they cut service calls.

Get Latest Information

Illustrated literature and specification sheets gladly sent free. Write Petro, 3193 West 106th Street, Cleveland 11, Ohio.

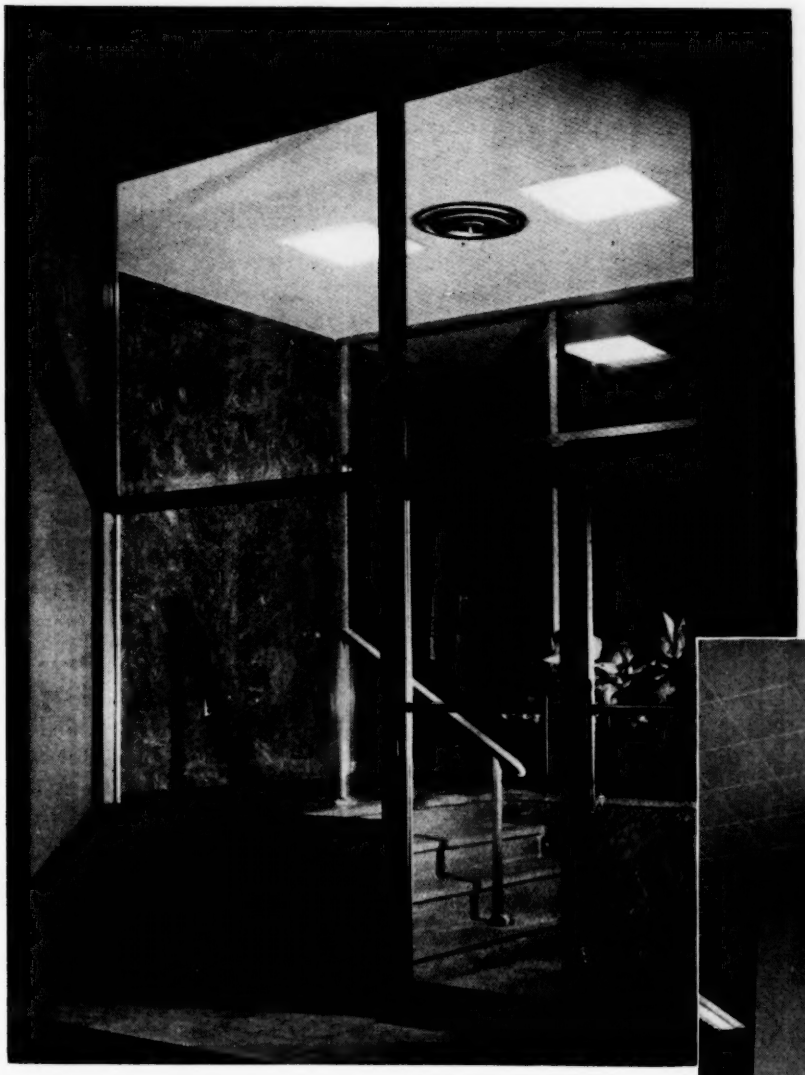
INDUSTRIAL—COMMERCIAL—RESIDENTIAL OIL BURNERS FOR EVERY FIRING NEED

PETRO

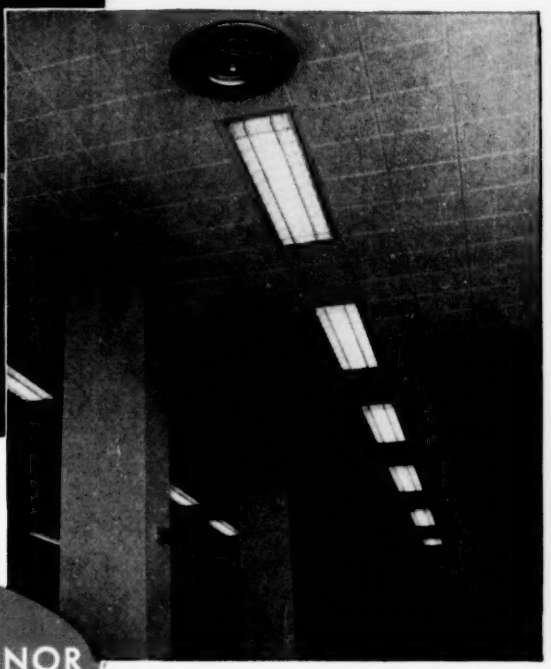
50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING

3193 W. 106th St., Cleveland 11, Ohio

Anheuser-Busch new office building, St. Louis, Mo. • **Architect:** Rathman, Koelle and Carroll, St. Louis, Mo. • **Consulting Engineer:** John D. Falvey, St. Louis, Mo. • **Heating Contractor:** T. J. Sheehan Company, St. Louis, Mo.



the Beauty of it is...



YOU CAN COUNT on handsome Kno-Draft Adjustable Air Diffusers to distribute your conditioned air — warm or cool — in just the right volume and flow pattern to assure the comfort of *uniform temperature without drafts* throughout the conditioned space.

What's more, the fact that Kno-Draft is adjustable *after* installation means less slide rule work for you, and greater flexibility of control to meet both present and future conditions.

You'll find Kno-Draft Adjustable Air Diffusers doing their highly efficient jobs in a large and ever-growing number of America's notable and architecturally significant buildings. You can get them in types and sizes to meet all engineering and architectural requirements.

KNO-DRAFT DATA BOOK: Complete specifications, engineering and installation data on Kno-Draft Adjustable Air Diffusers. Write for your copy, or simply fill in and mail the coupon. No obligation, of course.

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Please send me the *new edition* of the Kno-Draft Data Book — without obligation, of course.

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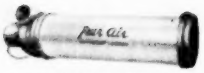
Position.....

Company.....

Street.....

City.....Zone.....State.....

PORTABLE



FRESH'NER

PUR-ETTE

FILTER FOLD

PANEL ADSORBER

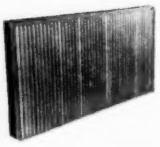
CANISTER

PORTABLE

Remove Odors Completely with

Pur Air

activated, coconut-shell carbon equipment



PARTIAL-AIR-BY-PASS

FIXED MOUNT

Pur Air ACSC* equipment actually removes odors . . . doesn't hide or mask them. The odors and gases stay right in the carbon, and the purified air is returned ready for re-use. Great economies are realized in heating or cooling costs by such re-use of room temperature air.

Pur Air makes use of the time-proved principle of the gas-mask, using activated carbon to adsorb odors and gases. Only pure coconut-shell carbon is activated for Pur Air equipment, since over 15,000 tests prove it to be the most effective material.

For air intake and recirculation ducts adsorber plates, filter-fold, partial-air-by-pass or canisters are used. Portable units are used in hospital wards, veterinary hospitals, taverns, cocktail lounges, conference rooms, etc. . . . fixed mount in industrial areas and cold storages. The Fresh'ner is used for rest rooms and dressing rooms. The Pur-Ette is just the thing for home use, in kitchen or lavatory.

WRITE FOR SPECIFICATION SHEETS TODAY

In Pur Air equipment you get the maximum Pur Air ACSC* for your money . . . and after all it's the carbon that does the job. Quality control is positive, because Pur Air is the ONLY manufacturer that both PRODUCES activated, coconut-shell carbon and BUILDS the equipment, too.

***ACSC: activated, coconut-shell carbon**

Pur Air DIVISION

BARNEBEY-CHENEY *Company*

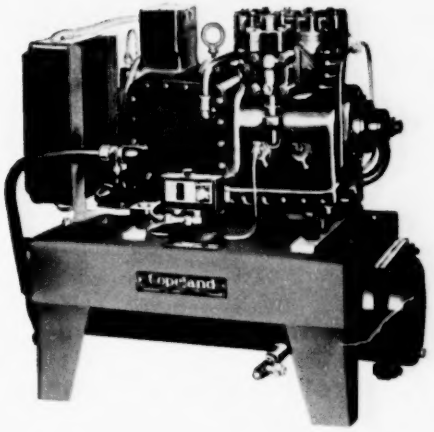
(Successor to American Solvent Recovery Corp.)

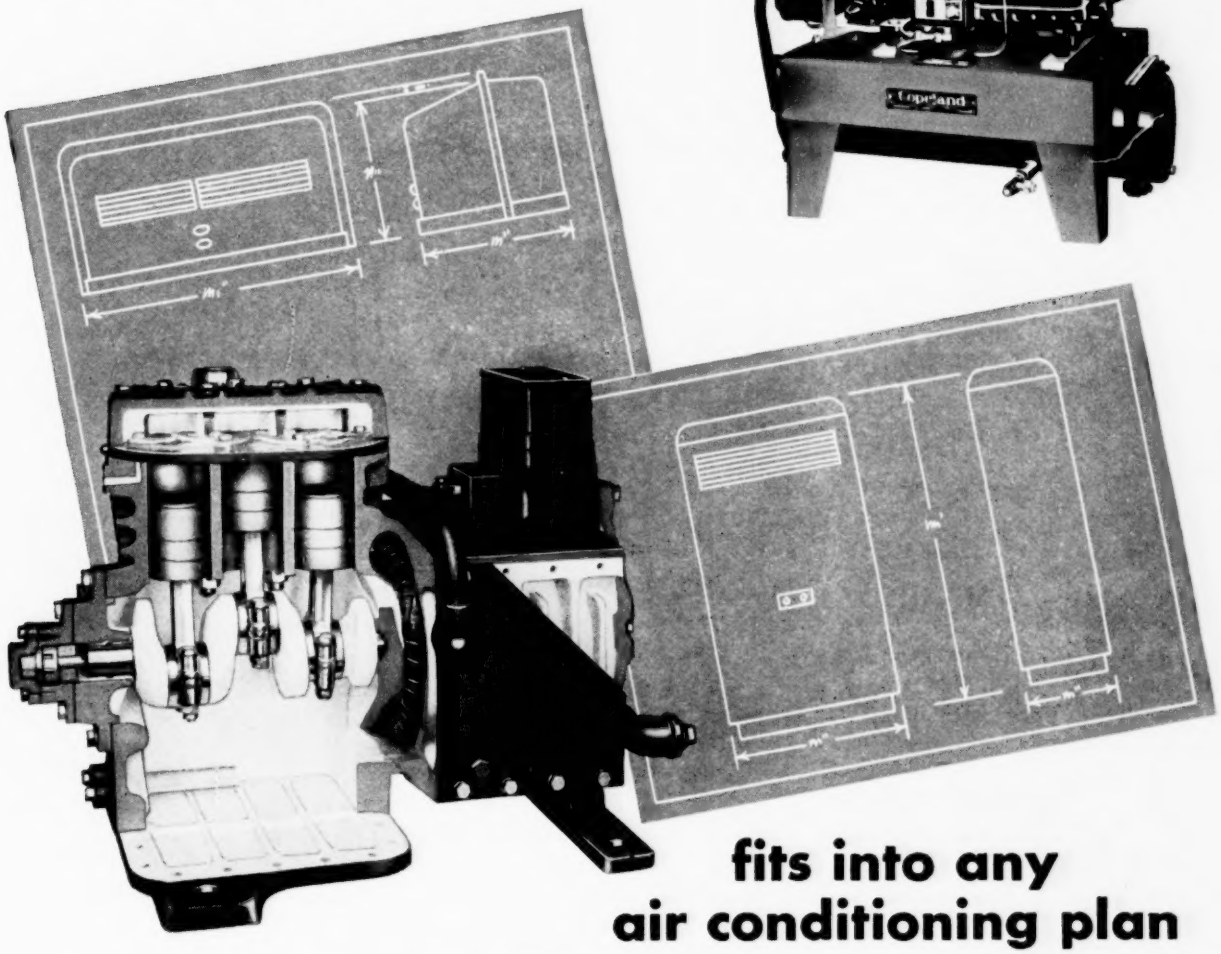
N. Cassady at Eighth Columbus 19, Ohio

WORLD'S LARGEST PRODUCER OF GAS-ADSORBENT CARBONS

COPELAMETIC

THE *Accessible* HERMETIC



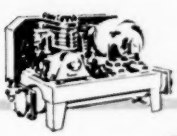


Cutaway of 7½ H.P. COPELAMETIC Motor-compressor

fits into any air conditioning plan

Whether it's a room air conditioner, a large package unit or a huge factory system, COPELAMETIC is your answer to the question "Which refrigeration unit shall I recommend for the air conditioning system?" COPELAMETIC has become the standard of comparison for dependability, ruggedness, compactness and long life. Your clients will appreciate the COPELAMETIC design which eliminates belts, seals and manual oiling . . . reasons for 9 out of 10 service calls. Better yet, they'll appreciate the practical feature of accessibility.

Air-cooled, remote COPELAMETICS are built from ¼ thru 3 HP. There are also water-cooled, remote units from ⅓ thru 7½ HP. Self-contained COPELAMETICS are available for all applications. Write for Condensed Catalog C-52.



REFRIGERATION UNITS
(OPEN TYPE AND COPELAMETIC)
WATER COOLERS

Copeland
DEPENDABLE *Electric* REFRIGERATION

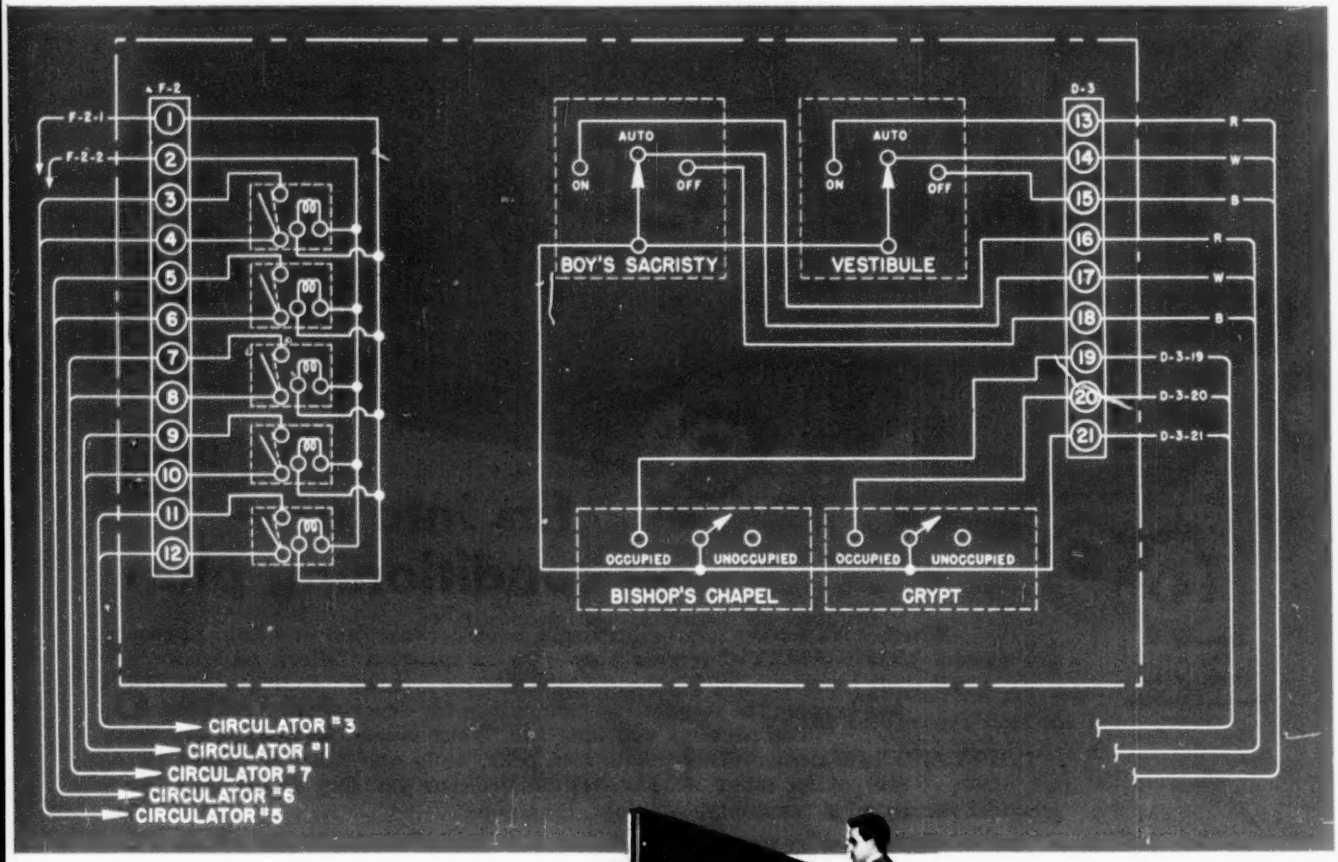
COPELAND REFRIGERATION CORPORATION, SIDNEY, OHIO

BARBER COLMAN

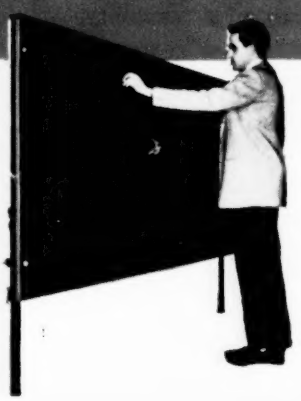
ELECTRIC Control Center

13-zone heating system in remodeled cathedral controlled by central panel "nerve center"

St. Mary's Cathedral, Fall River, Massachusetts. Interior redesigned by Maginnis & Walsh, with Richard D. Kimball Co., engineers in charge of mechanical design. Heating contractor, Fred Williams, Inc. Entire automatic temperature control system furnished and installed by Barber-Colman Company.



Simplified installation *results from Barber-Colman technique of employing a control center with prewired accessories—switches, relays, transformers, resistors, etc.—and numbered terminal strips for connecting all components of electric control system. Schematic drawing for one section of complete prewired cabinet (above) illustrates method.*



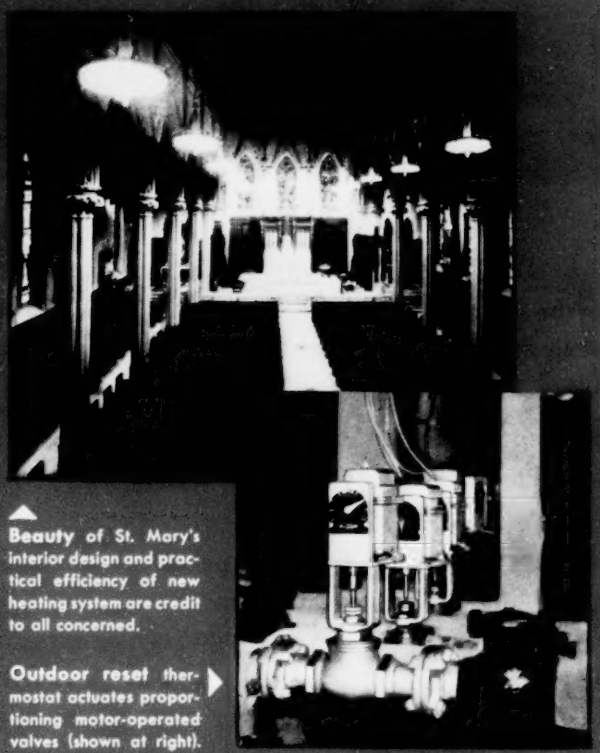
Serviceman *checks entire system from master temperature "Control Center" in the equipment room.*

Contractors seeking faster, cost-saving methods of installation . . . with "right-the-first-time" performance . . . are welcoming Barber-Colman's Electric Control Center which "packages the headache" of a control job.

Many a surprised engineer has discovered that this "Control Center" approach permits him to install a modern electric temperature control system—on large or small jobs—often at substantial savings.

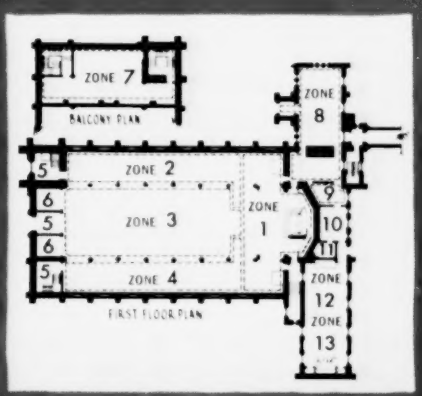
A "Control Center" panel-cabinet is the key unit of the Barber-Colman system. Prewired internally, and housing all accessory equipment, this "nerve center" minimizes field errors, and permits complete check of system before delivery to the job. "Revisions" are easily made at the cabinet without running extra conduit or probing for junction boxes. Panel terminal strip numbers in the cabinet, plus numbered components, and numbered or coded wires, reduce wiring job to simple matching of corresponding numbers. Diagram showing conduit layout and number of wires required can be placed on bidding plans, resulting in realistic bids.

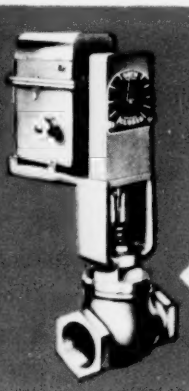
Heating system in remodeled St. Mary's Cathedral, Fall River, Massachusetts, is fully described with details of this modern method in illustrated brochure, obtained by sending the coupon below.



Beauty of St. Mary's interior design and practical efficiency of new heating system are credit to all concerned.

Outdoor reset thermostat actuates proportioning motor-operated valves (shown at right).





13 zones controlled—9 zones of floor panel radiant heating; 2 zones of direct radiation with convectors; 2 zones served by large capacity unit heaters.

Modern electric controls and engineering assistance are available at once from nearby Barber-Colman office.

BARBER COLMAN

ELECTRIC

Control Center

Automatic Controls · Air Distribution Products · Machine Tools · Small Tools
Molded Products · OVERdoors · Industrial Instruments · Textile Machinery

BARBER-COLMAN COMPANY, ROCKFORD, ILL., U. S. A

Gentlemen: I'm interested in learning more about the St. Mary's installation and details of panel "Control Center."

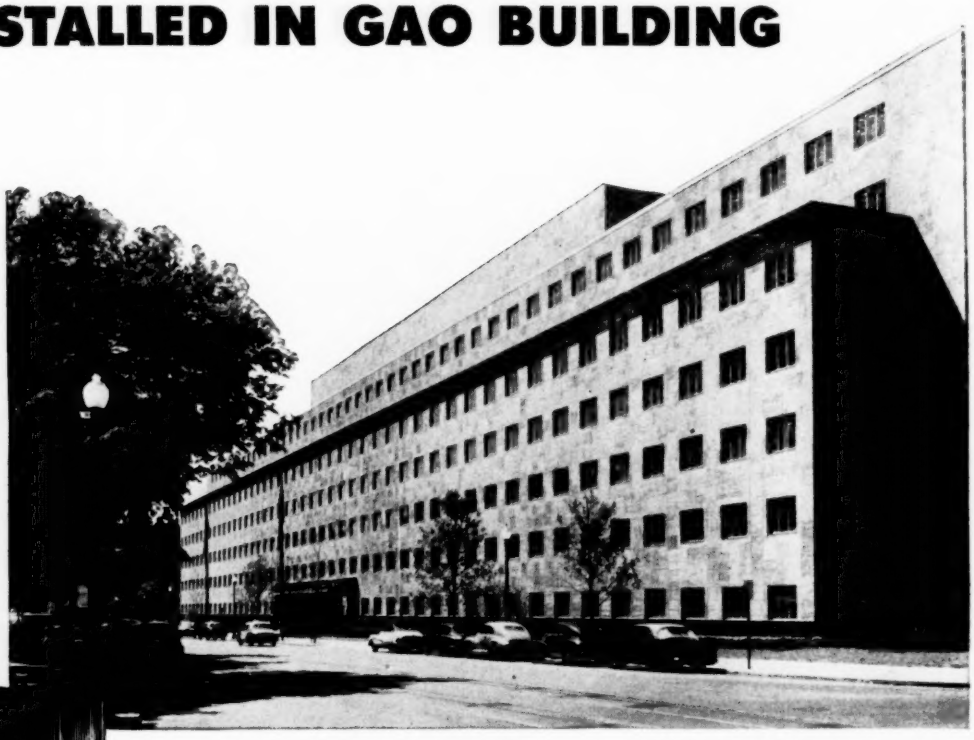
Name_____

Firm Name_____

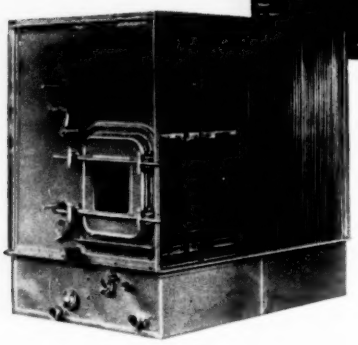
Address_____

City_____ State_____

47 *Marlo* DEHUMIDIFIERS INSTALLED IN GAO BUILDING



General Contractor:
John McShain Co., Philadelphia
Air Conditioning Contractor:
W. H. Singleton Co.
Architects and Engineers:
General Services Administration, Public Buildings Service



MARLO Dehumidifiers are equipped to handle all humidifying, cooling and dehumidifying needs. Equipped with specially designed brass atomizing spray nozzles. Spray headers and risers of red brass pipe. Tank, casing and eliminators are cold rolled copper, all framing and structural members extruded brass.

The new $25,000,000 home of the General Accounting Office is, except for the Pentagon, the largest government building in the Washington area. It is a massive limestone structure, seven stories high, and covers an entire city block.

This unique "block-type" building has no wings or courtyards. Interior areas must depend upon air conditioning for proper ventilation.

Forty-seven MARLO Spray Type Dehumidifiers, with chilled water coils of approximately 4200 tons cooling capacity, were chosen for this gigantic task. Every minute, 1,000,000 cubic feet of "conditioned" air is carried to all parts of the building through 27 miles of ducts . . . keeping this "watchdog of the U. S. Treasury" alert at all times.

Marlo
COIL COMPANY

Manufacturers of COOLING TOWERS • EVAPORATIVE CONDENSERS • INDUSTRIAL COOLERS • AIR CONDITIONING UNITS • MULTI-ZONE UNITS • BLAST HEATING & COOLING COILS

Saint Louis 10, Missouri

ADJUSTABLE PIPE HANGERS AND SUPPORTS

for every piping requirement

NO. 5 OF A SERIES SHOWING THE GRINNELL LINE

SOCKETS
COUPLINGS
TURNBUCKLE

Socket only for split ring fig. 110R 3/8 to 3/8 in. rod

Weldless eye nut fig. 290 3/8 to 1 1/2 in. rod

Forged steel clevis fig. 299 3/8 to 1 1/2 in. rod

Turnbuckle drop forged steel fig. 230 3/8 to 1 1/2 in. rod

Rod coupling fig. 136 3/8 to 3/8 in. rod

Adj. swivel coupling fig. 134 3/8 to 3/8 in. rod

Turnbuckle adjuster fig. 114

Rod coupling fig. 208 toggle bolt fig. 209 3/8 to 3/8 in. rod

U-HANGERS
EXTENSION
CEILING PLATE

Standard U bolt fig. 137

Adj. wrought U pipe hanger fig. 252 3/8 to 3/8 in. rod

Extension piece fig. 157 3/8 to 3/8 in. rod

Spring Ceiling plate fig.133 3/8 to 3/4 in. rod

ASSEMBLIES

Split ring with socket and coach screw

Split ring, socket and ceiling flange

Extension split ring hanger fig. 139

Adj. swivel ring with coach screw fig. 100

Adj. clip hanger fig. 106

Call your local Grinnell Distributor, or write for Hanger Catalog.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

Manufacturer of: pipe fittings • welding fittings • forged steel flanges • steel nipples • engineered pipe hangers and supports
Thermolier unit heaters • Grinnell-Saunders diaphragm valves • prefabricated piping • Grinnell automatic fire protection systems

More and More Leading Engineers are Now Recommending

Amocel®

PIPE INSULATION

WITH ITS SUPERIOR STRUCTURAL VALUES

(For 3¢ you can get the whole story)

UNARCO

UNION ASBESTOS & RUBBER COMPANY

DEPT. B-4, 332 SOUTH MICHIGAN AVENUE, CHICAGO 4, ILLINOIS

91% are p-k equipped*

*Yes, 91% of New York skyscrapers use p-k heat exchange equipment—instantaneous hot water heaters, storage water heaters, preheaters, condensate coolers, converters, freon coolers, etc. You get the finest when you specify p-k.

the **Patterson-Kelley Co.,** inc.

East Stroudsburg, Penn.

101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities

NEW SHOPPING CENTER USES

Frick Unit Conditioners have a blue-grey Hammermatic finish that blends well with any surroundings.

FRICK Air Conditioning THROUGHOUT

The eleven stores in the big new Freedom Shopping Center in Baltimore, built and owned by Henry J. Knott Enterprises, are all kept cool and comfortable with Frick Unit Air Conditioners. Several of these are tied-in with heaters of year-'round use. Installation by the Paul J. Vincent Co., Baltimore Distributors who have put Frick Air Conditioning in over 100 theatres.

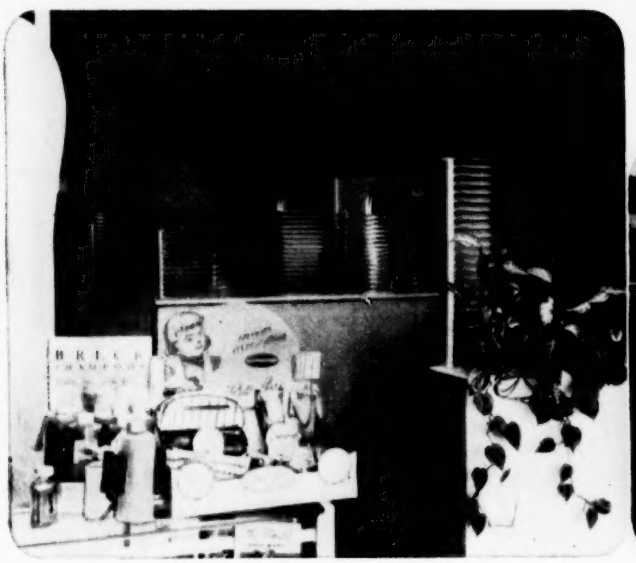
Frick Refrigerating and Air Conditioning Equipment can solve YOUR cooling problems equally well. Write

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

Also Builders of Power Farming and Sawmill Machinery



The Beauty Salon and Drug Store at Freedom Shopping Center.

Engineered FOR SMOOTH FLOW

TUBE-TURN Eccentric Reducers are designed with strong knuckle contours and as gentle transitions from large to small diameters as possible. In addition to providing smooth inner walls at the joints, these features hold turbulence and pressure loss to a minimum.

Efficient piping flow reduces pumping power requirements, and investment in equipment. For efficient, leakproof piping, specify welded systems—using TUBE-TURN Welding Fittings and Flanges.

You'll find a TUBE TURNS' Distributor in every principal city. Call him for good service in good connections.

Be sure you see the double "tt"

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

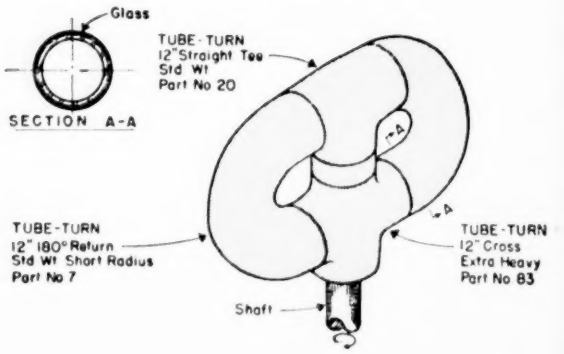
Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO

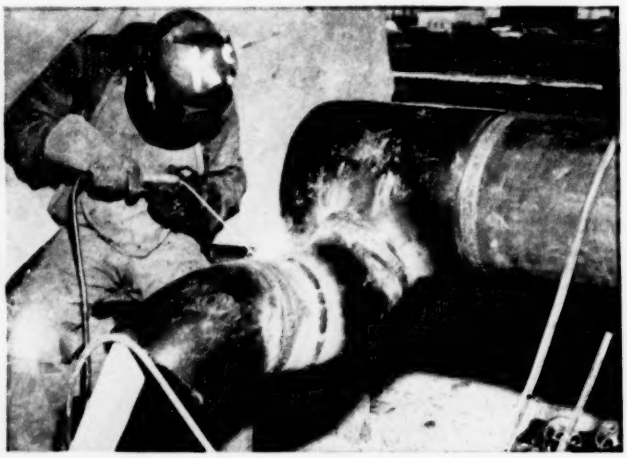
PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA. • KEROTEST MANUFACTURING COMPANY, PITTSBURGH, PA.

TUBE TURNS' *Engineering Service*
HELPS SOLVE A VIBRATION PROBLEM

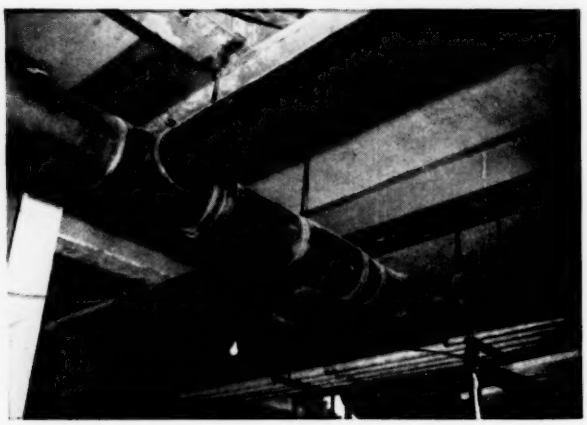
TUBULAR CONSTRUCTION often solves tough machine design problems and here, as in piping problems, Tube Turns' Engineering Service is ready to help you! For example:

Vibration was cracking the glass coating of a plate type agitator for a brine tank in a chemical plant. After repeated replacements, the engineers decided to switch to tubular construction and called in Tube Turns' Engineering Service for design assistance. The resultant design, shown in the sketch, embodies great rigidity and is not affected by the vibration. The expensive maintenance caused by cracking of the agitator's glass coating was eliminated.

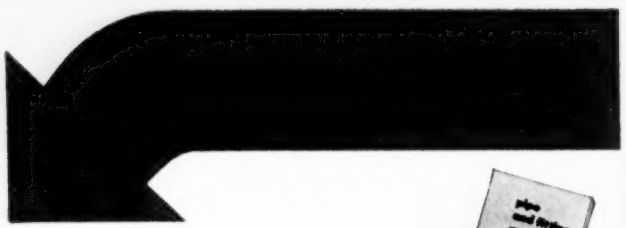




FABRICATION IS FAST. Field or shop fabrication of piping assemblies is easier when welders can count on the dimensional accuracy of TUBE-TURN Welding Fittings. True circularity and uniform wall thickness assure perfect lineup and fit.



AT GENERAL ELECTRIC. Two 16-inch steam mains, at boiler plant of the new G-E Appliance Park in Louisville, will help distribute 900,000 pounds of steam per hour efficiently. Welded piping, using TUBE-TURN Welding Fittings and Flanges, was specified for all critical lines in the new plant: high and low pressure steam, gas, domestic and mill water, and compressed air.



TUBE TURNS, INC., Dept. B-4
224 East Broadway • Louisville 1, Kentucky

Your name .....

Position .....

Company .....

Nature of business .....

Address .....

City ..... *State* .....

DISTRICT OFFICES

New York	Houston
Philadelphia	Tulsa
Pittsburgh	San Francisco
Chicago	Los Angeles

"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

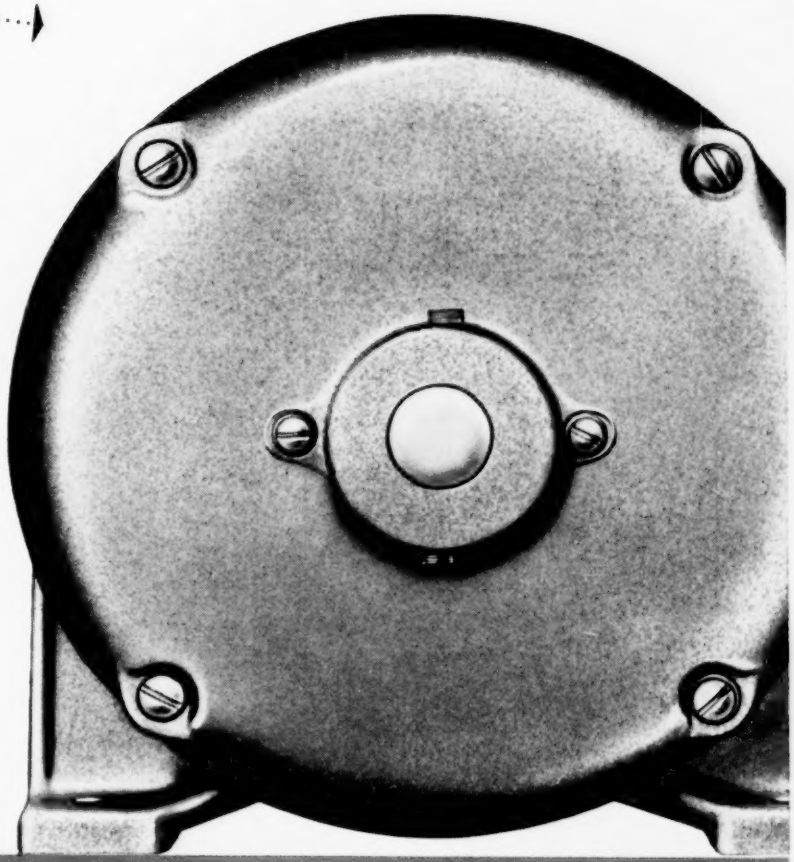
TUBE TURNS, INC.
LOUISVILLE 1, KENTUCKY

DEPENDABILITY...
that builds dividends

Delco Motors

Delco integral motors are one item of manufacturing cost that does not come under the head of "variable." They are so consistently dependable in operation that they have a stabilizing effect on production costs—and on dividends.

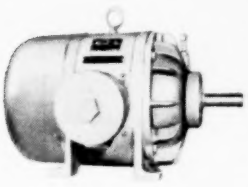
There are Delco motors for most applications—motors that will fit into **your** needs. A sales engineer from any one of the offices listed below will respond to your inquiry.



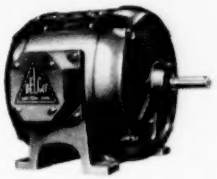
DELCO DAYTON OHIO

DELCO PRODUCTS

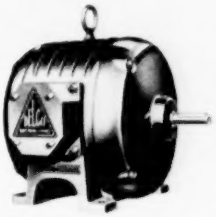
Division of General Motors Corporation
Dayton, Ohio



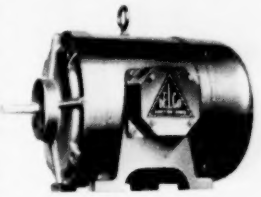
Explosion-Proof Motor



Open Ball-Bearing Motor



Totally Enclosed Motor



Totally Enclosed Fan-Cooled Motor

SALES OFFICES: Atlanta • Chicago • Cincinnati • Cleveland • Dallas • Detroit • Hartford • Philadelphia • St. Louis • San Francisco

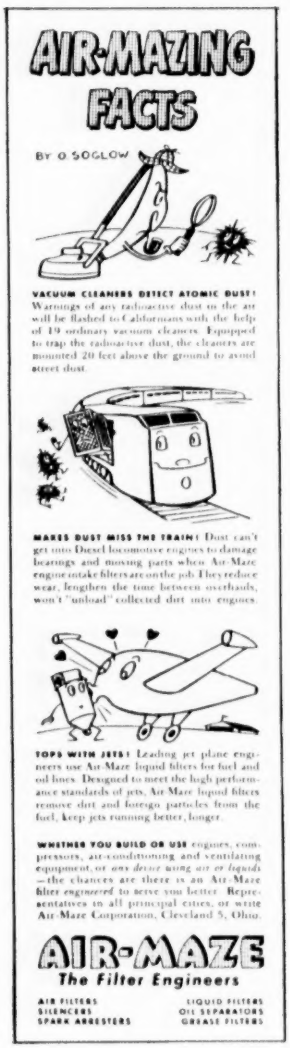
We'll pay $10.00 for AIR-MAZING facts like these:

VACUUM CLEANERS DETECT ATOMIC DUST! Warnings of any radioactive dust in the air will be flashed to Californians with the help of 19 ordinary vacuum cleaners. Equipped to trap the radioactive dust, the cleaners are mounted 20 feet above the ground to avoid street dust.

GOLD MINE IN THE SKY! Smoke from the chimneys of ore smelting plants used to carry away valuable gold, silver and copper in the form of waste dust. By trapping the dust, they now save millions of dollars worth a year.

SLEEPING VOLCANOES ARE WARMING WINTERS! Since 1912, volcanic eruptions have been declining, winter temperatures rising. Scientists see a connection. Fifty years ago, volcanic dust blocked up to 20% of the sun's rays; today this heat is getting through.

to use in national advertisements like these:


AIR-MAZING FACTS
BY O. SOGLOW
VACUUM CLEANERS DETECT ATOMIC DUST! Warnings of any radioactive dust in the air will be flashed to Californians with the help of 19 ordinary vacuum cleaners. Equipped to trap the radioactive dust, the cleaners are mounted 20 feet above the ground to avoid street dust.
MAKES DUST MISS THE TRAIN! Dust can't get into Diesel locomotive engines to damage bearings and moving parts when Air-Maze engine intake filters are on the job. They reduce wear, lengthen the time between overhauls, won't "unload" collected dirt into engines.
TOPS WITH JETS! Leading jet plane engineers use Air-Maze liquid filters for fuel and oil lines. Designed to meet the high performance standards of jets, Air-Maze liquid filters remove dirt and foreign particles from the fuel, keep jets running better, longer.
WHETHER YOU BUILD OR USE engines, compressors, air-conditioning and ventilating equipment, or any device using air or liquids—the chances are there is an Air-Maze filter engineered to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.
AIR-MAZE
The Filter Engineers
AIR FILTERS
SILENCERS
SPARK ARRESTERS
LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

AIR-MAZING FACTS
BY O. SOGLOW
GOLD MINE IN THE SKY! Smoke from the chimneys of ore smelting plants used to carry away valuable gold, silver and copper in the form of waste dust. By trapping the dust, they now save millions of dollars worth a year.
KEEPS FIREMEN OUT OF KITCHENS! Air-Maze Greastop filters snatch dirt and grease droplets out of the air, help to prevent fire hazards in kitchen exhaust ducts. It's one of hundreds of filter types designed by Air-Maze—the filter engineers.
HELPS DEALERS CLEAN UP! There's big profit and repeat sales for those who sell nationally advertised Air-Maze DUSTAY® disposable filters for home warm air furnaces and air conditioning units. (If you're in the hardware, furnace or sheet metal business, write Air-Maze for details.)
WHETHER YOU BUILD OR USE engines, compressors, air-conditioning and ventilating equipment, or any device using air or liquids—the chances are there is an Air-Maze filter engineered to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.
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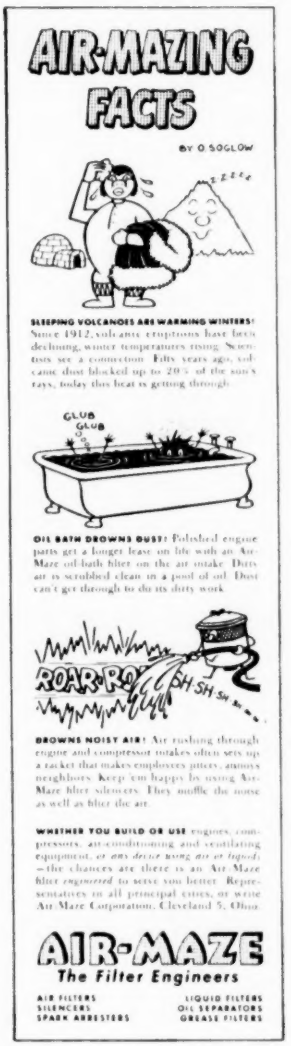
AIR-MAZING FACTS
BY O. SOGLOW
SLEEPING VOLCANOES ARE WARMING WINTERS! Since 1912, volcanic eruptions have been declining, winter temperatures rising. Scientists see a connection. Fifty years ago, volcanic dust blocked up to 20% of the sun's rays; today this heat is getting through.
GLUB GLUB
OIL BATH DROWNS DUST! Polished engine parts get a longer lease on life with an Air-Maze oil-bath filter on the air intake. Dirty air is scrubbed clean in a pool of oil. Dust can't get through to do its dirty work.
ROAR-R-R-R SH-SH-SH
BROWNS NOISY AIR! Air rushing through engine and compressor intakes often sets up a racket that makes employees jittery, annoys neighbors. Keep 'em happy by using Air-Maze filter silencers. They muffle the noise as well as filter the air.
WHETHER YOU BUILD OR USE engines, compressors, air-conditioning and ventilating equipment, or any device using air or liquids—the chances are there is an Air-Maze filter engineered to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.
AIR-MAZE
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AIR FILTERS
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GREASE FILTERS

Do you know any unusual facts about dust and air like the Air-Mazing facts at the top of this page? We'll pay $10.00 for each fact we accept and publish. Send fact and source of its origin to Air-Maze Corporation, 25000 Miles Road, Cleveland 28, Ohio.

THE expert's CHOICE

FOR HIS OWN HEADQUARTERS, a contractor naturally selects the Heating Specialties he knows from experience to be tops in performance — long lasting — trouble-free. For it is not just his place of business, but also a working exhibit of the heating and piping equipment he recommends with confidence.

That's why you will find all

SARCO Heating Specialties

in the modern offices, basement and fabricating shop of Kaighin & Hughes Inc., Toledo, one of the largest heating and piping contractors in the Middle West.

Specify Sarco for quality, durability and trouble-free service.

Write for the Sarco Heating Bulletins.

Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Branches in principal cities. Sarco Canada Ltd., Toronto 8, Ont.

SARCO saves steam

sarco quality assures satisfaction

1. Air conditioner in basement. Air heating coils and drips fitted with Sarco float-thermostatic steam traps.

2. Office Building of Kaighin & Hughes Inc., Toledo. This leading heating and piping contractor recommends Sarco Heating Specialties and uses them in his own office building and shop.

3. A corner of the large drafting room of Kaighin & Hughes Inc., large heating and piping contractor in Toledo.

4. A view in the extensive pipe fabricating shop of Kaighin & Hughes, Inc., Toledo. Sarco heating specialties are both used and recommended by this contractor.

Radiator Trap | Radiator Valve | Float-Thermostatic Trap | Inverted Bucket Trap | Air Eliminator | Pipe Line Strainer | Temperature Regulator

417

Built for the U. S. Armed Forces by SOUTHERN STATES IRON ROOFING COMPANY, of Savannah, Georgia, these Rigid Steel Frame Buildings (Frigid Type) feature high resistance to outside temperatures, particularly cold; light weight; compact packaging for overseas shipment; ease of erection by troops in the field. They are insulated with Microlite Glass Fiber Insulating Wool.

Why Was MICROLITE Chosen to Insulate 1490 SSIRCO Prefabricated Buildings?

because effective cold and heat resistance was specified

MICROLITE *Glass Fiber Insulating Wool* is one of the most effective of all insulating materials and easily met rigid Government specifications. For example, ½ pound density Microlite used in these buildings has a "k" value of .26 at 75° F. mean temperature.

because extreme light weight was specified

MICROLITE is featherlight. For example, 24 sq. ft., ½ inch thick Microlite in ½ pound per cu. ft. density (Type B-305) weighs only 8 ounces.

because minimum bulk was specified

MICROLITE compresses approximately 4-to-1 for packaging, and springs immediately back to its original thickness when unpacked.

because ease of handling was specified

MICROLITE comes in soft, pleasant-to-the-touch, resilient blankets, easily cut, folded, bent, rolled, squeezed.

because other properties of Microlite were specified

MICROLITE is non-corrosive, fire-resistant, moisture-resistant; won't support fungi or bacteria; won't provide food for rodents, insects or vermin.

In meeting the rigid specifications laid down by Southern States Iron Roofing Company, recognized specialists in the construction of buildings for the Armed Forces, Microlite once again demonstrated its efficiency, versatility and adaptability. It is a wonderful insulating material for ducts, steam tracer lines and nested pipes, valves and fittings, domestic boilers and warm air furnaces. You can't conscientiously proceed with any insulating job until you've investigated Microlite, a product of Glass Fibers' own independent electronic-extrusion process. Glass Fibers Inc., 1810 Madison Avenue, Toledo 2, Ohio.

GLASS FIBERS INC.

Makers of glass fibers by the ELECTRONIC-EXTRUSION process . . . developed, patented and used exclusively by Glass Fibers Inc.

VITRON Yarns • Rovings • Micro-Fibers • Pipe Wraps • Industrial Mat • MICROLITE Thermal-Acoustical Insulation • DURAMAT Vapor Barriers • VIBRAGLASS Machinery Mounting and Packaging Materials • COUSTIC-AIRE and THERMO-JET Aircraft Insulations.

"MILLIONS of FEET of READING COPPER TUBING

Used Because of Long, Trouble-Free Service ... Time and Labor-Saving Installation"

Says

C. WALLACE PLUMBING CO.,

One of the Southwest's Oldest and Largest Mechanical Contractors!

Founded in 1902 by Carl Wallace, now the retired dean of the plumbing industry in Texas, the C. Wallace Plumbing Co. of Dallas, Houston, and Tulsa has grown in the past 50 years to be recognized as one of America's leading plumbing, heating and air conditioning contractors. Like many other outstanding contracting firms, the C. Wallace Plumbing Co. has chosen Reading Copper Tubing for many of their largest installations.

Chief among the reasons for this widespread contractor preference for Reading Copper Tubing are its uniform wall thickness, precision quality, ease of bending and resulting reduction in number of fittings required. You can profit by the experience of these contractors and enjoy these benefits by remembering to *specify Reading Copper Tubing when you order from your plumbing and heating supply wholesaler.*

Sam P. WALLACE
President

Frank E. WALLACE
Vice Pres. & Treasurer

Carl Preston WALLACE
Secretary

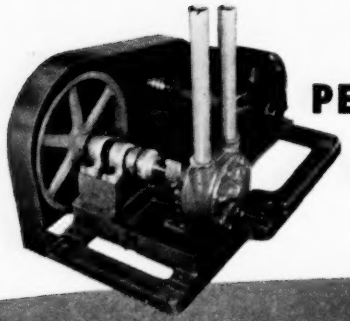
READING TUBE CORPORATION

Producers of Reading Lektroneal Copper Tubing and Reading 85% Grade A Red Brass Pipe

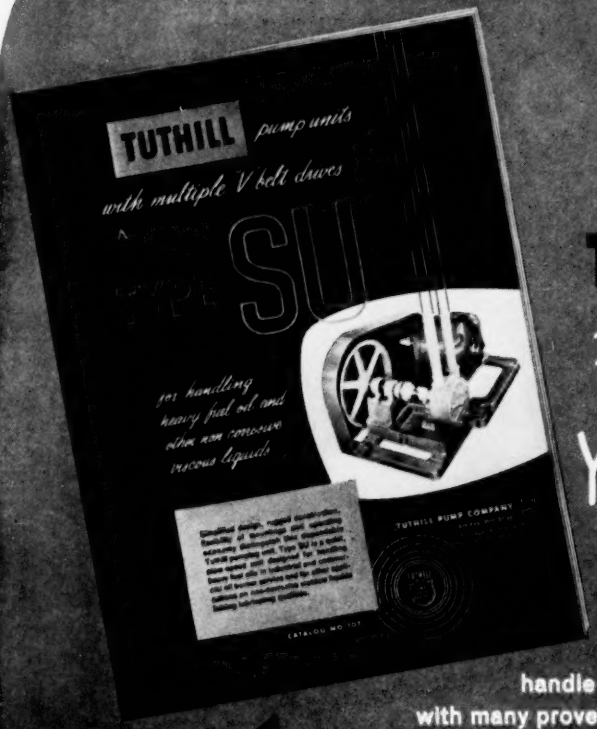
OFFICES AND EASTERN DISTRIBUTION DEPOT:
36-12 47th Ave., Long Island City, N. Y. • STillwell 6-9200
WORKS: READING, PA.

READING COPPER BRASS TUBING

DISTRIBUTION DEPOTS: Reading, Pa. • Long Island City, N. Y. • Houston, Texas, 1121 Rothwell St. Chicago, Ill., 724 W. 50th St. • Atlanta, Ga., 690 Murphy Ave. S.W. Unit 5, Bldg. B



PERFORMANCE PACKED FOR INDUSTRIAL OIL BURNER SERVICE


TUTHILL pump units
with multiple V-belt drives
SU
for handling heavy fuel oil and other non-corrosive viscous liquids
TUTHILL PUMP COMPANY

Get the Facts on the New TUTHILL TYPE SU Pumping Unit to Meet Your Heating Requirements

The new Tuthill Type SU is a multiple V-belt driven pumping unit designed to handle heavy fuel oils in industrial heating service. Along with many proved structural and performance features, it provides flexibility to a degree never before available. Advantages like the following make it outstanding for your needs:

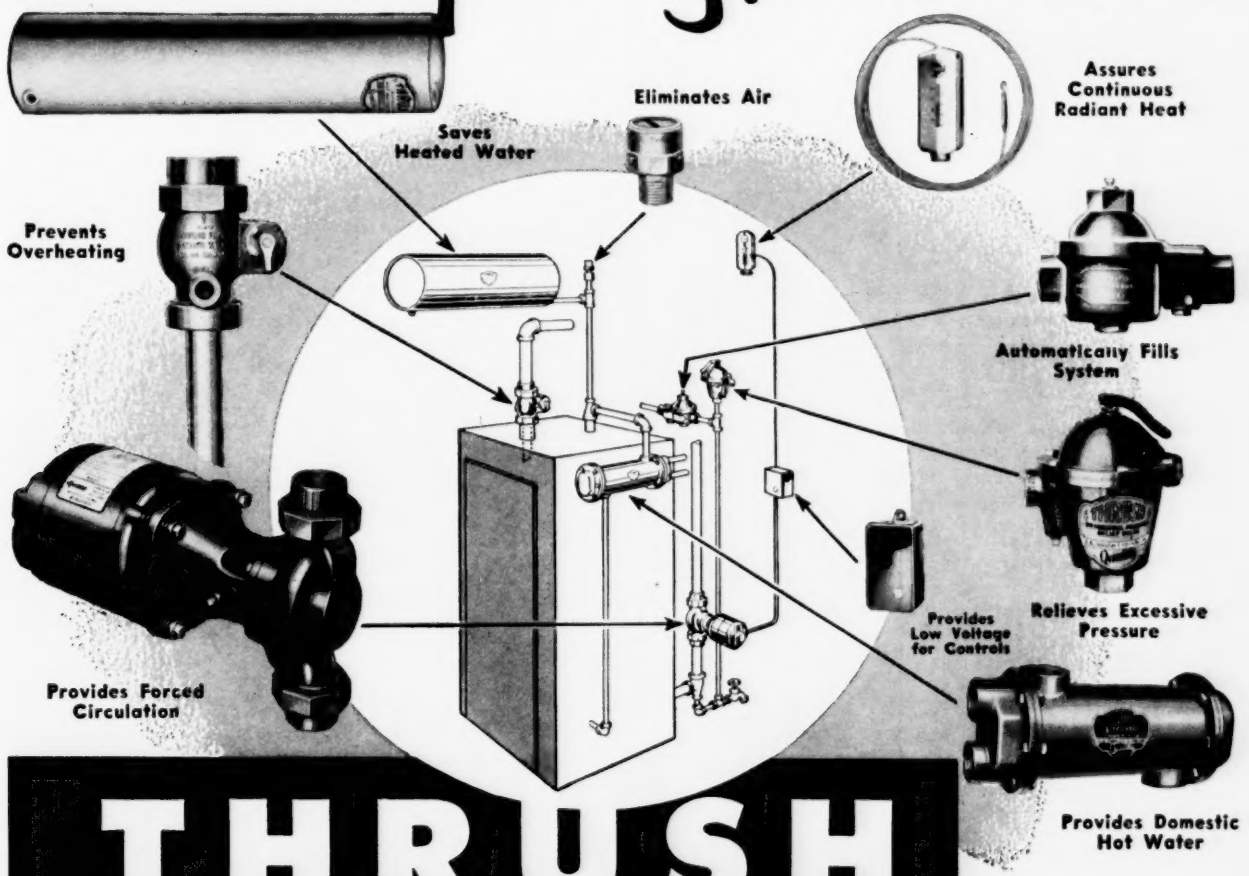
- ★ One-point belt-tension adjustment
- ★ Motors up to 5 H.P. mounted on slotted slide rails for easy adjustment or replacement. No drilling or tapping required.
- ★ Cast iron base with mounting bolts and adjustments accessible.
- ★ Jack shaft supported by ball bearing pillow blocks carries the entire weight of the pulley and absorbs belt tension.
- ★ V-Belt drive handles 1 to 4 belts.
- ★ Integral drain pan—generous sump for clean, convenient servicing.
- ★ Removable guard.
- ★ Pump, jack shaft and pillow blocks available as separate unit
- ★ Pump and jack shaft direct-connected by flexible coupling for better alignment and simplified mounting
- ★ Wide range of pump models and capacities

Complete data on this timely Tuthill development is presented in Tuthill Catalog No. 107. Write for your copy today.

TUTHILL
PUMP COMPANY
Dependable Pumps since 1927
939 East 95th Street,
Chicago 19, Illinois

TUTHILL
PUMPS FOR THE PURPOSE

Sell Completely Automatic



THRUSH flow control HOT WATER HEATING

SUCCESSFUL DEALERS, who install Thrush Flow Control Systems on all their hot water heating jobs, tell us that every Thrush installation sells another one. Enthusiastic home owners tell their friends . . . build good will . . . and that means more sales and profit for you.

Thrush Flow Control System has everything to make sales easier and satisfy customers . . . unlimited choice of heating units (baseboards, radiant panels, convectors, etc.,) . . . fuel economy . . . small piping . . . comfort (less than 1° room temperature variation) . . . plenty of domestic water from the one boiler and years of trouble-free service. Sell the best heating equipment — SELL THRUSH. See your wholesaler for free Sales Helps and Free Engineering Service or write Dept. D-4 today!

H. A.
THRUSH
& COMPANY
PERU, INDIANA

Assures a Continuous Flow of Radiant Heat

When you figure the pipe you can be sure—

if it's National

● A lot of people have faced a lot of piping problems over the last 60 years. During that time, so many of them have solved their requirements with one pipe—NATIONAL Steel Pipe—that they have made NATIONAL the largest selling pipe in the world.

Other things have helped too . . . the fact that one integrated organization has complete control of U·S·S NATIONAL Steel Pipe production, from the raw material to the finished product . . . the fact that advanced steel-making facilities and special pipe manufacturing processes are here combined with the experience of thousands of skilled craftsmen to produce steel pipe of uniformly high quality and utmost dependability.

As a result, when you decide on NATIONAL Steel Pipe you can be sure you'll always get pipe whose metallic structure, strength, sound joints, superior cutting, bending and threading properties assure easy installation and long, trouble-free performance.

These are the reasons why "old timers" swear by NATIONAL Steel Pipe and why NATIONAL is being consistently specified by the new generation of architects, engineers and contractors. In turn they have found that for low cost, easy installation and *proved* reliability in service, no other pipe quite fills the bill like NATIONAL.

So when you need an all-purpose steel pipe . . . make it NATIONAL.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION
PITTSBURGH, PA.

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S NATIONAL Steel PIPE

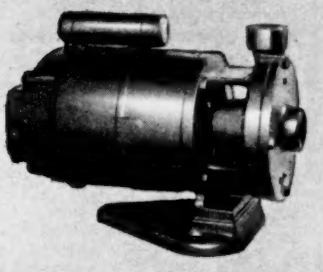
UNITED STATES STEEL

ALLIS-CHALMERS

Air Conditioning PUMPS

Easy-to-Install pumps

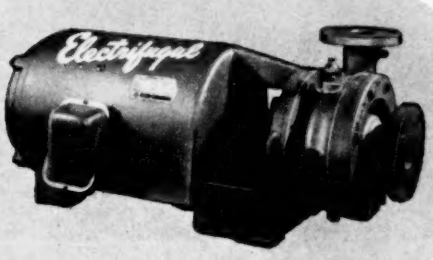
MEET 90% OF AIR CONDITIONING NEEDS



FHP pump

Up to 80 gpm, heads to 125 feet.

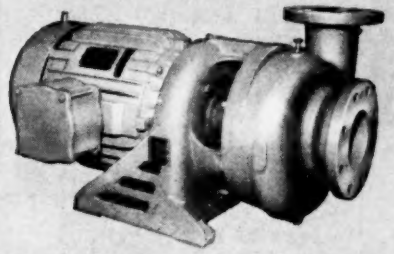
Compact pump and motor requires only two bolts for installation. Rigid construction holds alignment for longer bearing and seal life. Mechanical seal. Open impeller economy model does adequate job on many installations at very low cost. Closed impeller model for higher heads. Also available as frame-type pump for separate mounting.



Electrifugal pump

Up to 500 gpm, heads to 220 feet.

Only pump with unit-cast frame. Motor and pump are mounted on a single shaft in a one-piece rigid cast-iron frame. Alignment is rigidly held but there is plenty of space for maintenance. Installation requires only four bolts. Standard packing or mechanical seal available. Also built as frame-type pump for separate mounting.



Supporting adapter pump

Up to 2500 gpm, heads to 550 feet.

Flange motor and pump mounted on sturdy cast-iron supporting adapter. Motor and pump use same shaft. Rigidity assures vibrationless operation and long bearing life. Only four bolts required for installation. Available with standard packing or mechanical seal. Built in same ratings as frame-type pump for separate mounting.

FREE ENGINEERING HELP

YOUR ALLIS-CHALMERS PUMP REPRESENTATIVE is thoroughly familiar with pump problems in air conditioning equipment. He can offer you valuable suggestions in planning your equipment and installations. Call your Allis-Chalmers Authorized Distributor or District Office when you need help with your pump problems.

Write Allis-Chalmers, Milwaukee 1, Wisconsin, for centrifugal pump Bulletins 52B7529, 52B6140 and 52B6083 describing these air conditioning pumps.

A-3971

Electrifugal is an Allis-Chalmers trademark.

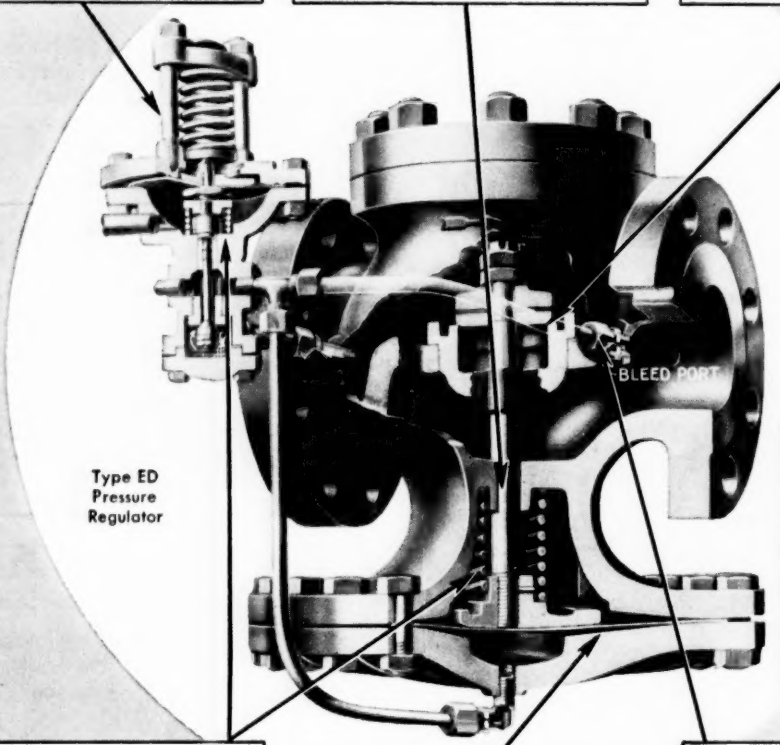
ALLIS-CHALMERS

ONLY SPENCE REGULATORS ...give you all these design advantages

Separate Interchangeable Pilot . . .
controls main valve . . . simplifies inspection and maintenance.

Packless Construction . . .
minimizes friction . . . improves control accuracy and eliminates much time-consuming maintenance.

SECO Metal Seats and Discs . . .
resist wiredrawing. More than 20 years of experience has failed to produce a single case where SECO Metal was cut by steam.



Type ED Pressure Regulator

Dead-End Shutoff . . .
guaranteed on steam service when a balanced, single-seated main valve is equipped with SECO Metal seat and disc and is protected by an approved strainer.

Internal Springs . . .
out of path of steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life.

Large Balanced Metal Diaphragms . . .
located in a cooled zone with a condensate seal above and below, under usual conditions, never need replacement.

Ease of Inspection . . .
quick access to all vital elements of regulator. No special tools needed.

These Spence design features explain why Spence Regulators function dependably and accurately year after year, without requiring extensive repairs or special attention. This lowers over-all costs . . . means less down-time of the system. • Spence makes a complete line of automatic regulating valves: pressure reducing, differential pressure, back pressure control, pump governor, temperature regulating and other types. Write for Bulletin giving full details.

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

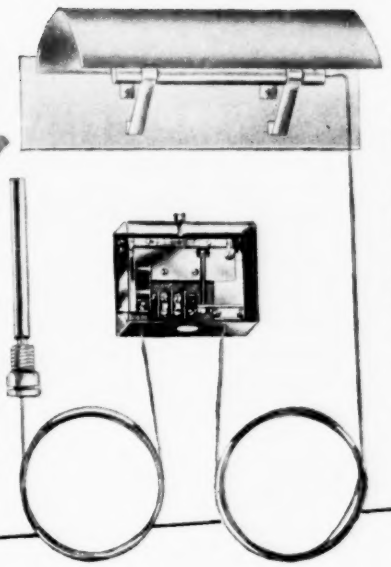
SE 122

Comfort...always comfort!

with **SARCOTHERM**

COMPENSATING OUTDOOR CONTROL

for hot water, radiant or warm air heating systems.



SARCOTHERM COMPENSATING INDOOR-OUTDOOR CONTROL, TYPE AO-1

Temperature is automatically reset by outdoor temperature changes so as to maintain comfort inside. (Not suitable where domestic hot water is taken from the same heating source.)

Schematic diagram showing simple hook-up for hot water, radiant heat or warm air heating systems.

Sarcotherm Engineers are always glad to help with installation data.

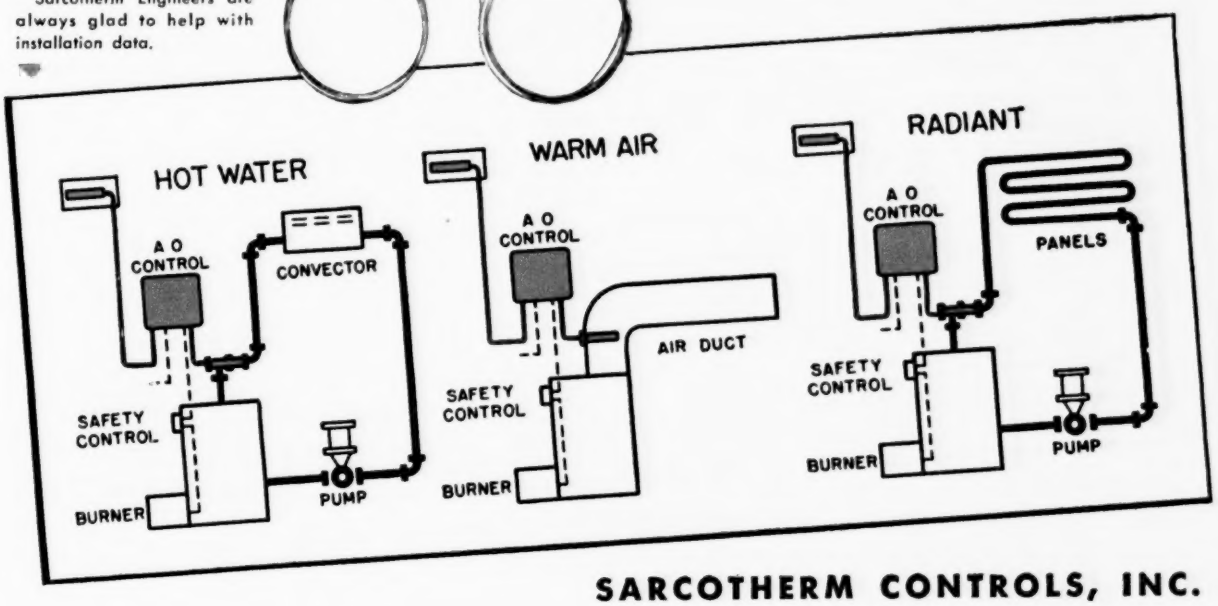
HERE is the ideal automatic temperature control for homes heated by hot water, radiant heat or hot air.

It automatically varies the circulating water (or air) temperature in accordance with outdoor temperature changes.

It can be easily adjusted for any desired control setting and will maintain comfort temperatures desired inside, regardless of the weather.

For low cost, accuracy of control and simplicity of installation, Sarcotherm type AO-1 is without equal.

Complete engineering information in Bulletin ST 600, free on request.



SARCOTHERM CONTROLS, INC.

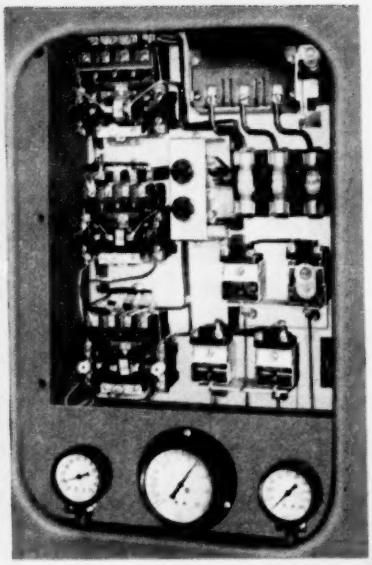
Complete Line of Temperature Controls for Heating

EMPIRE STATE BUILDING • NEW YORK 1, N. Y.

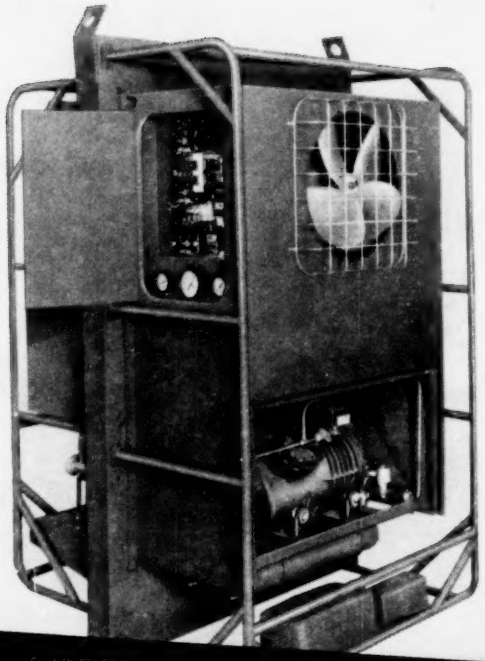
Branches in principal cities—Factory at Bethlehem, Pa.

26

A SARCO PRODUCT



Close-up of the control panel, showing Allen-Bradley solenoid starters, high pressure cutout, and remote bulb temperature controls.



AMANA completely self-contained plug-in type refrigeration unit, fully equipped with Allen-Bradley motor controls.

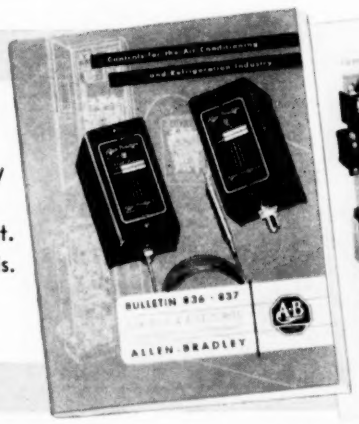
AMANA REFRIGERATION UNIT *equipped with* ALLEN-BRADLEY TROUBLE FREE MOTOR CONTROLS

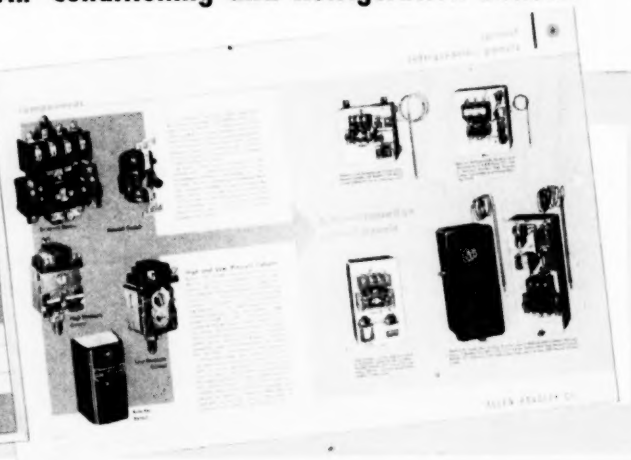
A-B Quality

Why are Allen-Bradley starters so popular for refrigeration and air conditioning service? . . . because they are trouble free. Only ONE moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them! No contact maintenance . . . Allen-Bradley silver alloy contacts never need cleaning, filing, or dressing. Dependable overload relays . . . Allen-Bradley thermal relays are accurate and always dependable . . . even after long service.

Write **for this Allen-Bradley Air Conditioning and Refrigeration Bulletin**

Allen-Bradley Company
1330 S. Second St.
Milwaukee 4, Wis.





ALLEN-BRADLEY QUALITY MOTOR CONTROLS

FIRST *complete* packaged boiler

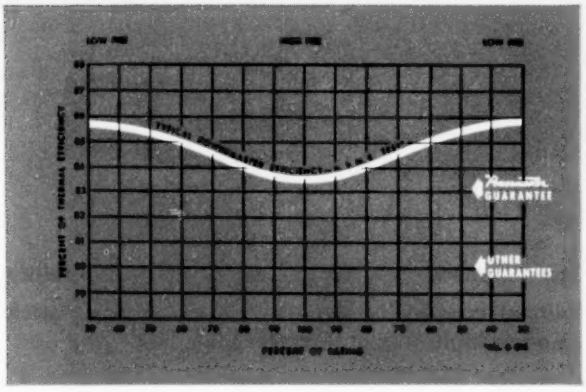
FIRST full modulating cam control

FIRST *Voriflow* air-atomizing burner

FIRST immediate change-over—oil or gas

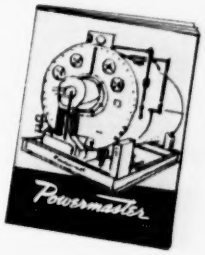
NOW—*Powermaster*® is FIRST to guarantee 83% minimum efficiency

The "pay-off" on a boiler is its operating efficiency . . . and *only Powermaster guarantees a minimum of 83%* with No. 6 oil!



Take a look at the typical efficiency curve of *Powermaster* shown here . . . then compare A.S.M.E. tests with those of any other boiler. At less than full load (which is normal in field operation) notice that *Powermaster* efficiency actually *increases.*

There's a reason for such efficiency. The *Powermaster* is the development of 68 years' experience in boiler manufacture. Continuing research and progressive engineering have resulted in *Powermaster* users being the first to benefit from major improvements in packaged boiler design.

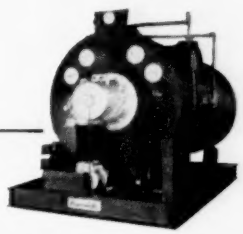


Point-by-point, *Powermaster* welcomes comparison. Before deciding on a new boiler for your plant, be sure to get the facts on the newest *Powermaster* with *Voriflow* combustion. Just drop us a line and we'll be glad to send you our new catalog.

Powermaster®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



ORR & SEMBOWER, INC. • *Established 1885* • 980 MORGANTOWN ROAD, READING, PENNA.

HERE'S YOUR *Complete* STEAM PLANT

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.
- For complete details, write today for catalog 519.

SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES, Inc.

Factory: Emmaus, Pa.

Executive Offices: Times Building, Times Square, New York 18, N. Y.

GET DOUBLE PROTECTION!

ONLY STAYNEW

AUTOMATIC AIR FILTERS HAVE THIS DRY CURTAIN.....

Staynew Model A-3 Automatic is the only air filter designed to give the *double protection* of double filter curtains—the first wet, the second dry. There's never oil entrainment and the cleaned side of curtains is always on the filtered air side. Staynew Model A-3 Filters are designed for both light dust load installations and for heavy duty industrial service where large volumes of air are to be filtered.

Automatic Self Cleaning Type Filter

- Highest efficiency of any mechanical type automatic filter.
- Exceptionally large dust holding capacity.
- Absolutely no oil entrainment in air stream.
- Motor and control unit mounted on clean side of filter.
- Combination gear and roller chain drive (no belts to slip).

Bring your filtration problems to Staynew. If the filtration of large volumes of dirty air at high efficiency and low cost is required, let the Dollinger engineers show you how and why Staynews are your answer. Write for descriptive folder.

Representatives in Principal Cities

DOLLINGER MFG. PROTECTOMOTOR U.S. PAT. OFF. STAYNEW FILTERS

DOLLINGER CORPORATION

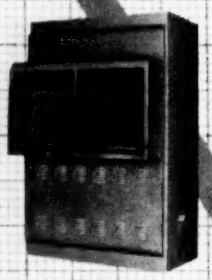
15 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

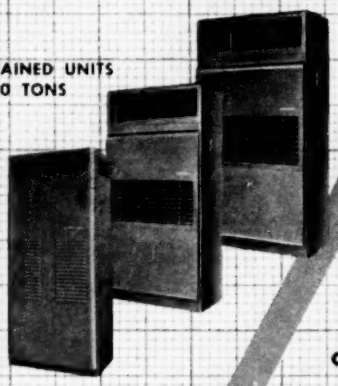
Quality-Engineered by

TYPHOON

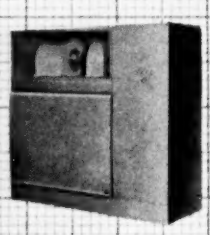
DEPENDABLE EQUIPMENT FOR YOUR AIR CONDITIONING NEEDS



SELF-CONTAINED REMOTE UNITS
15 AND 20 TONS



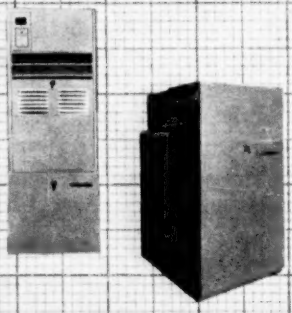
SELF-CONTAINED UNITS
1½ TO 10 TONS



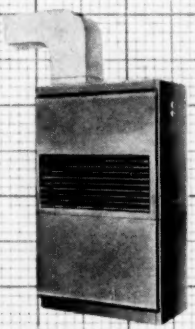
EVAPORATIVE CONDENSERS
3 TO 20 TONS

Whether the job calls for a single packaged air conditioning unit or a central plant . . . a residential year-round unit or a heat pump — you can count on Typhoon equipment to supply your needs. And Typhoon's quality engineering — backed by over 40 years of experience — is your guarantee of trouble-free performance.

Satisfied Typhoon users include famous companies like RCA, Grand Union Stores and Whelan Drug Stores. They've found Typhoon equipment tops in economical operation . . . tops in cooling efficiency. You will, too.



RESIDENTIAL SUMMER-WINTER UNITS
2, 3, 5 TONS



PROP-R-TEMP HEAT PUMPS
2 TO 20 TONS

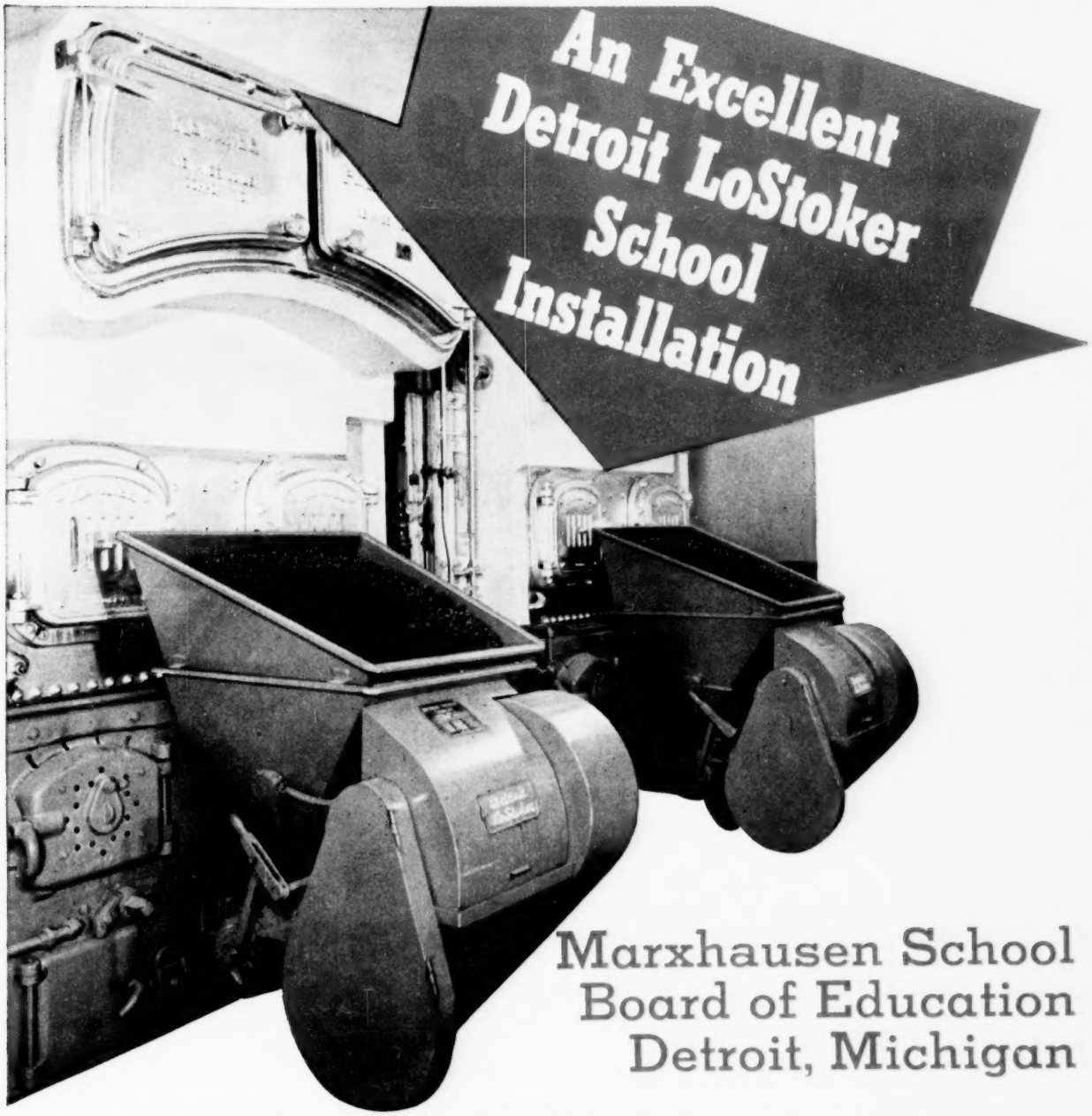
Also . . .
Heating and Cooling Coils
Air Handling Units
Cooling Sections to Supplement Furnaces
Water Chillers
Multi-Package Systems
Steam or Water Boilers
Window Units ⅓, ½, ¾ and 1 HP

Write for Detailed Information

TYPHOON AIR CONDITIONING CO., INC.

794 Union Street, Brooklyn 15, N. Y.

Specialists in Air Conditioning Since 1909



An Excellent Detroit LoStoker School Installation

Marxhausen School Board of Education Detroit, Michigan

Detroit LoStokers that provide heat for Marxhausen School, Detroit, Michigan, are equipped with Detroit Adjustable Feed Coal Feed Controls which proportions coal and air at all loads. The installation was part of a modernization program which included new boilers.

Marxhausen is one of many Detroit schools equipped with Detroit Stokers—ideal for school heating plants. They are responsive and reliable . . . operate with high thermal efficiency. Maintenance cost is exceptionally low.

Write for literature on Detroit Stokers.

There is a size and type of Detroit Stoker for every heating and power need.

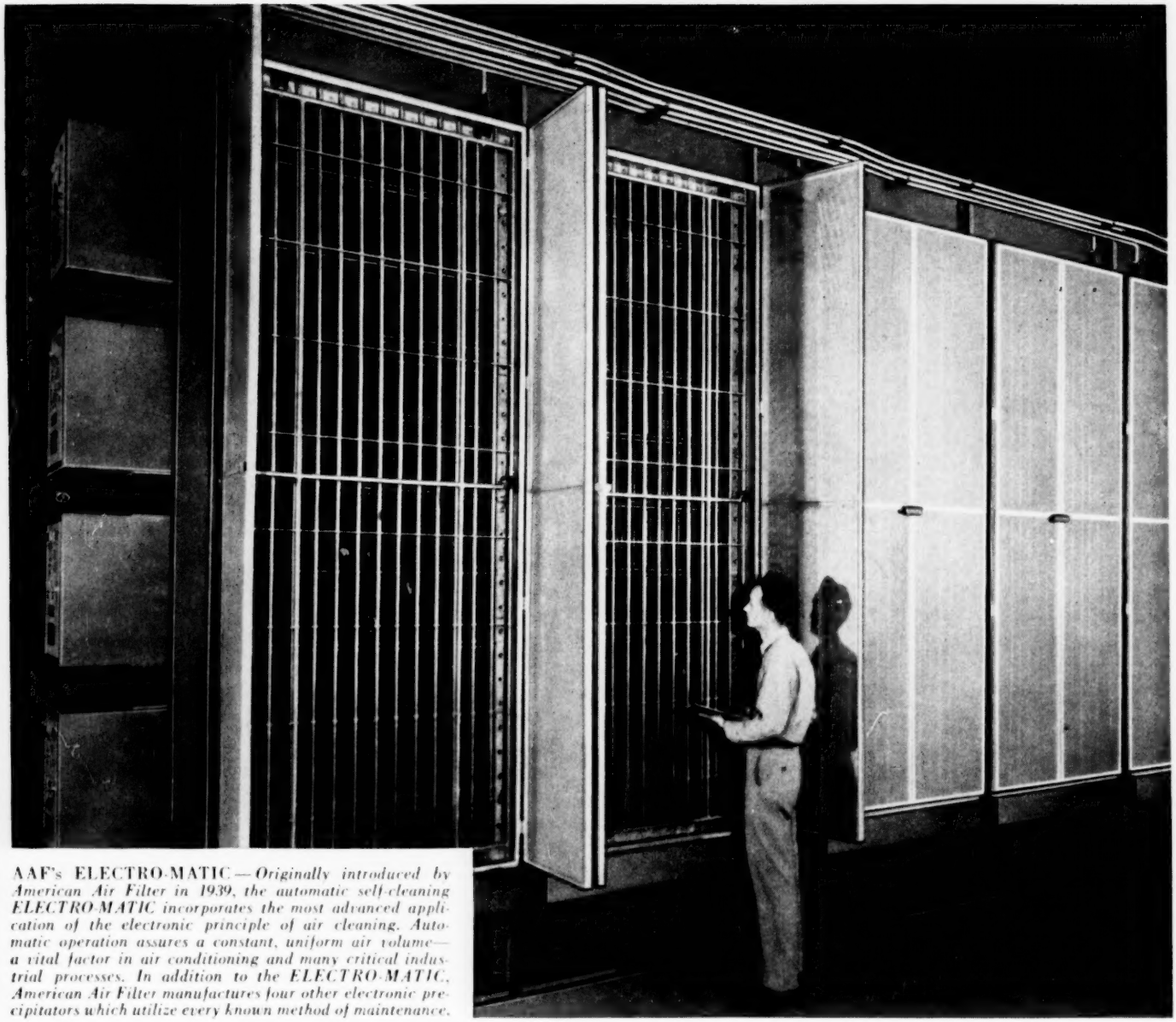
DETROIT STOKERS

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities

Why five types of

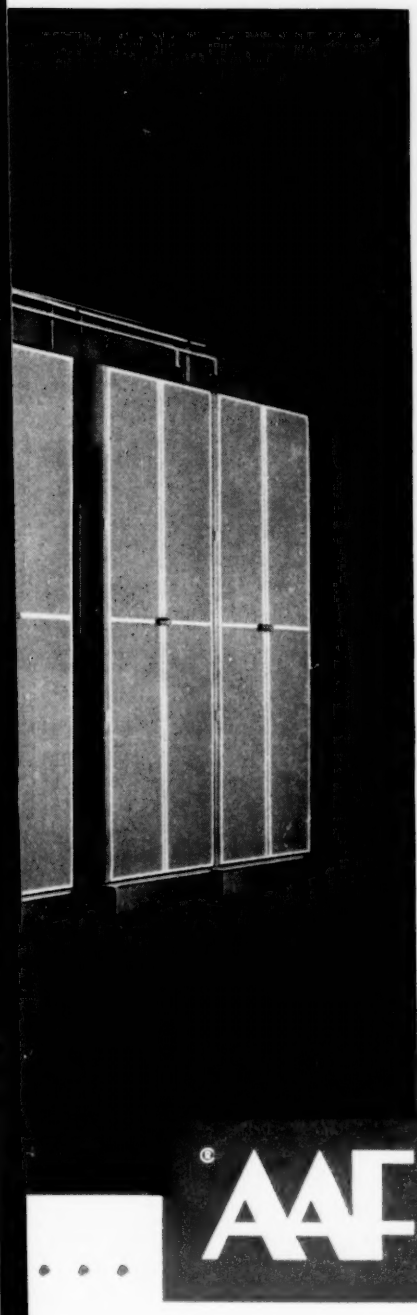


AAF's ELECTRO-MATIC — *Originally introduced by American Air Filter in 1939, the automatic self-cleaning ELECTRO-MATIC incorporates the most advanced application of the electronic principle of air cleaning. Automatic operation assures a constant, uniform air volume— a vital factor in air conditioning and many critical industrial processes. In addition to the ELECTRO-MATIC, American Air Filter manufactures four other electronic precipitators which utilize every known method of maintenance.*

a single source for all air cleaning equipment . . . . . .

ELECTRO-CELL | ELECTRO-PL | ELECTRO-MIST | ELECTRO-KLEAN | AUTO-AIRMAT | AIRMAT PL-24 (with felt) | AIRMAT PL-24

electronic air cleaners?



AAF's five distinct types of electronic precipitators have highly individual characteristics . . . for a reason! As part of AAF's complete line of air cleaning equipment, they were developed to meet complex and distinctly different air cleaning requirements for fine particle size in both commercial and industrial application. As a result, the engineer is given the opportunity to *select* from a wide range of performance characteristics, rather than to be restricted to one type of electronic precipitator and try to make it fit the job.

AAF's group of five electronic precipitators offer these selective features:

- Different Efficiency Ratios
- Several Methods of Maintenance
- Variety of Space Requirements
- Wide range of sizes and air volumes
- Practical and realistic range of initial costs

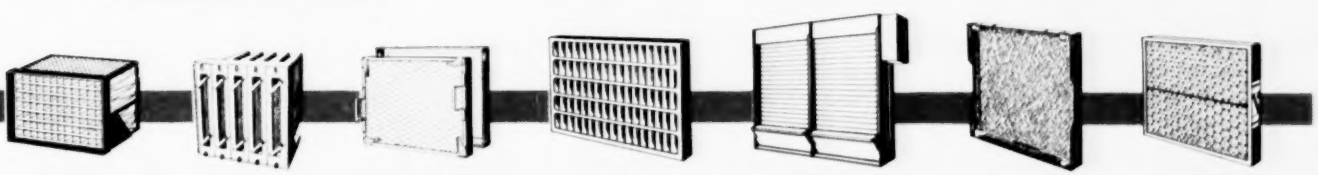
In addition to manufacturing the only complete line of air cleaning products, AAF's engineering staff is recognized as the leading authority in this field. The specialized knowledge of these men can save you time, effort and expense. If you have a dust problem, let us help you solve it.

Complete engineering data on all AAF equipment is available. Contact your nearest AAF representative, or write American Air Filter Company, Inc., 294 Central Avenue, Louisville 8, Ky.

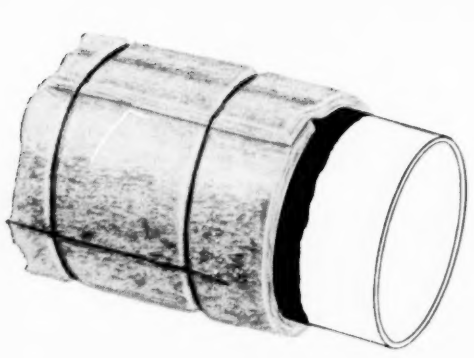
American Air Filter
COMPANY, INC.

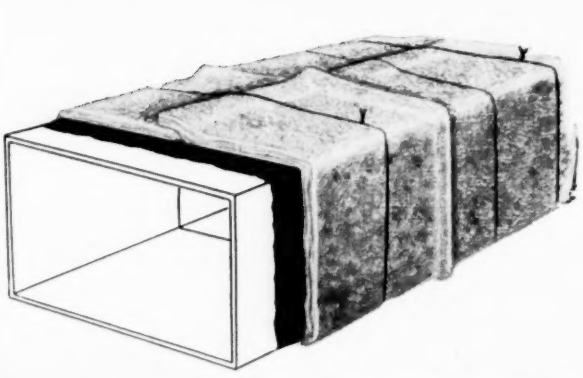
294 Central Avenue, Louisville 8, Ky.

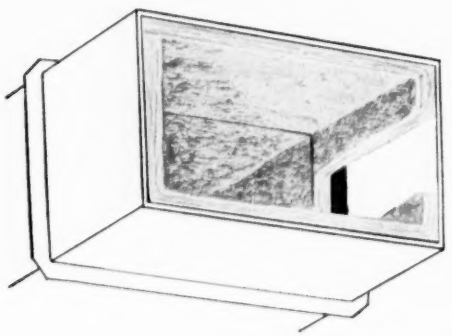
American Air Filter of Canada, Ltd., Montreal, P. Q.
Pacific Division Office, San Francisco, California



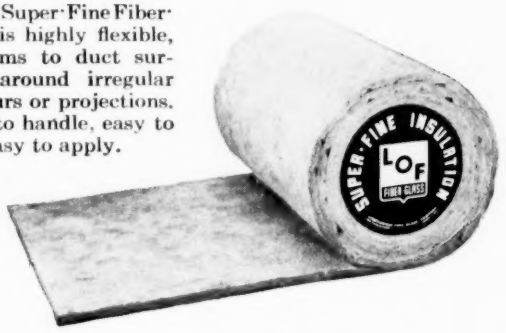
DEEP-PAK | DEEP BED | M/W-H/V UNITS | DRIFILTER | MULTI-DUTY | RENU-GLAS | AMER-GLAS







L·O·F Super·Fine Fiber·Glass is highly flexible, conforms to duct surface, around irregular contours or projections. Easy to handle, easy to cut, easy to apply.



How to do a first-class insulating job on cooling and heating ducts

FIRST, use L·O·F Super·Fine Fiber·Glass.

It's exceptionally efficient, needs little space. On heating ducts, it cuts heat loss sharply, saves fuel. On cooling ducts, it saves power, boosts over-all efficiency of system. As a duct liner, *faced* Super·Fine reduces sound of motors and blowers. And it lasts. Inorganic glass fibers won't burn, won't rot, won't absorb moisture. They're verminproof.

With L·O·F Super·Fine, you can give your customers first-class long-lived insulation jobs that back up your reputation for careful workmanship.

SECOND, send for free L·O·F folder on metal-air duct installations. In four meaty pages, it gives you helpful pointers about L·O·F Super·Fine's insulating and sound absorption properties, recommended installation steps, specifications, standard shipping sizes and other data.

FREE! Send for helpful installation folder. Libbey·Owens·Ford, Dept. F·G 3143, Wayne Building, Toledo 3, Ohio.

LIBBEY·OWENS·FORD GLASS COMPANY
FIBER·GLASS DIVISION

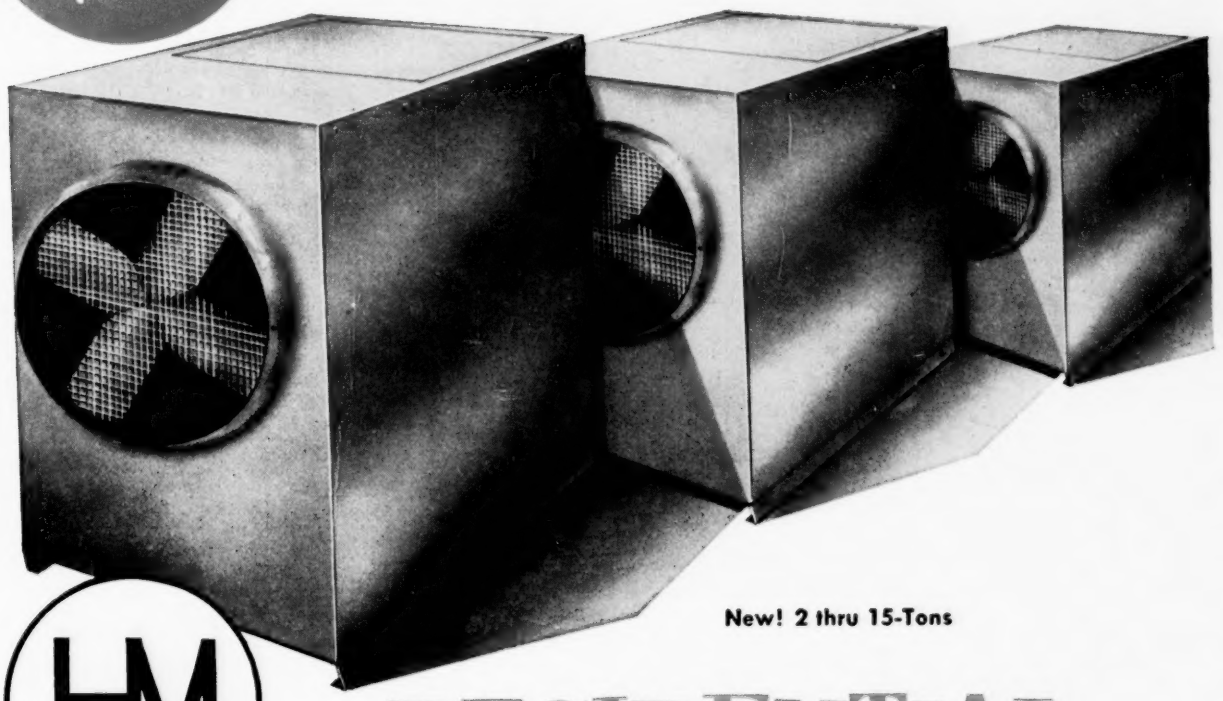
L·O·F GLASS PLASKON FIBER·GLASS

FIBER·GLASS

ANOTHER HALSTEAD & MITCHELL FIRST

20-Year Guarantee!

ON THE WETTED DECK SURFACE



New! 2 thru 15-Tons

HM

RESIDENTIAL COOLING TOWERS

PRICED FOR THE HOME MARKET

Price-wise these Halstead & Mitchell Residential Cooling Towers throw open huge segments of the home and small building market to air-conditioning. Here is the development for which the industry has been waiting. Check prices today!

NOW REQUIRED IN MANY AREAS

Residential Cooling Towers recirculate precious water . . . meet requirements of municipalities which prohibit wasting cooling water to sewers. And low cost H&M units take residential air conditioning to the suburbs and rural area . . . recirculate from a cistern if need be!

MADE FOR REAL OPERATING ECONOMY

Economical, lastworthy . . . low operating cost matches low initial cost. Efficient gravity-type distributing pan eliminates windage loss since atomizing by spray nozzle is unnecessary. Low pump head pressure is another bonus of gravity distribution. And maintenance is a snap!

FAMOUS HALSTEAD & MITCHELL QUALITY

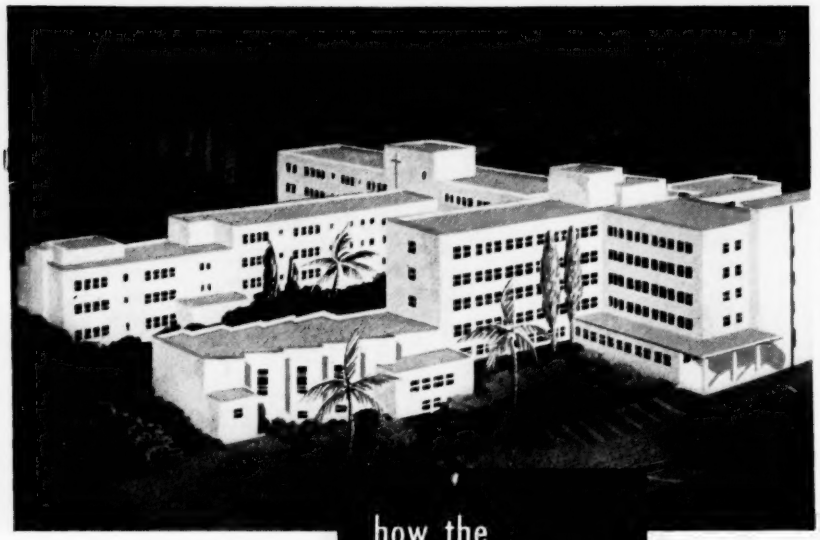
Here's *all* the quality for which Halstead & Mitchell Cooling Towers are world famous — including the 20-year Guarantee on the wetted deck surface of pressure-treated creosoted wood, against attack by rotting or fungi growth. Stainless steel fans and shafts, plus individual cabinet coatings of Vinsynite, Vinyl Zinc and chlorinated rubber add important years of life. The complete assembly is with Everdur bolts . . . disassembly is easy even after years of service.

AT LEADING WHOLESALERS EVERYWHERE

Write for descriptive bulletin from Halstead & Mitchell, one of the world's largest manufacturers of water-cooled Cleanable Condensers, and Cooling Towers up through 100-tons.

HM Halstead & Mitchell

OFFICES: BESSEMER BUILDING • PITTSBURGH 22, PA.



St. Francis Hospital in Lynnwood, California, selects the York High Velocity Double Duct System . . . the advanced system that permits individually-controlled air conditioning in rooms and wards.

• • •

Hugh Davies, Architect
Pozzo Construction Co., Contractors
Al Kleiber, Engineering Consultant

how the St. Francis Hospital can help solve your air conditioning problems . . .

You may have only a passing professional interest in the air conditioning problems of one of the world's most modern hospitals.

But this new, major development points out a solution to your air conditioning problems . . . *no matter what they are!*

You see, York Engineers work with the industry's *widest* range of equipment. They do not have to compromise—and try to fit a rigid system to a building or fit the building to a system.

They can recommend with broad impartiality, the installation that *precisely* suits the particular requirements of the building you are air conditioning. The result? Better performance, longer life at low initial and operating cost. No wonder York has installed more air conditioning and refrigeration capacity than all the others!

There is a York Engineering Office near you. The number is in your Classified Telephone Directory. A consultation with a York Engineer incurs no obligation, of course. It can lead to important savings in time, money and worry for you, as it has for so many others. Or write to York Corporation, York, Pennsylvania.

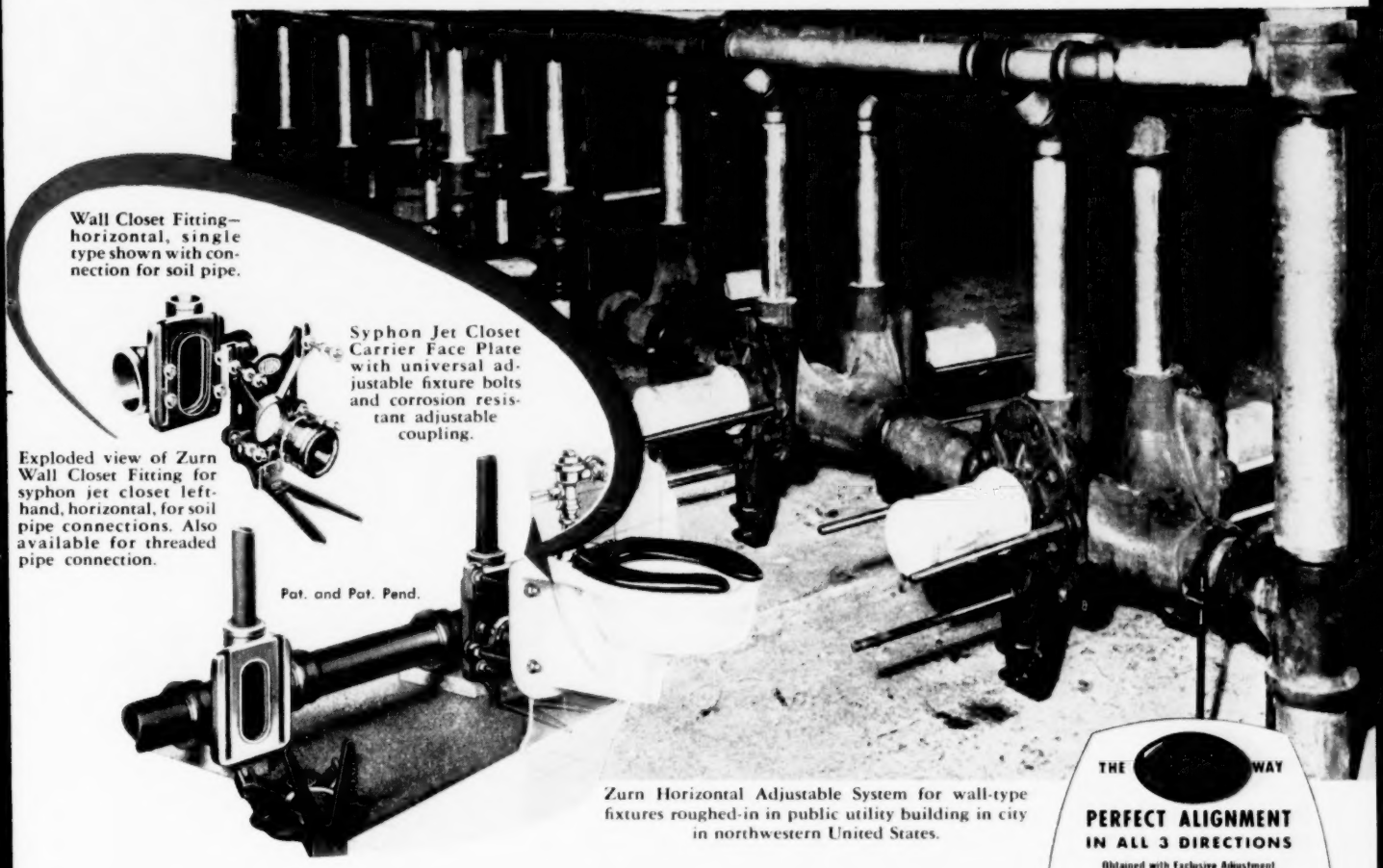
• • •

In every major trading center there is a York Engineering Office with men skilled in the arts of engineering, contracting, construction and service. They are constantly backed by continual factory research and product development in one field exclusively—air handling and mechanical cooling! They are at your service always!

YORK AIR CONDITIONING AND REFRIGERATION
HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

York refrigeration air-conditioning

ZURN SYSTEMS GIVES GREATER FLEXIBILITY FOR INSTALLING OFF-THE-FLOOR PLUMBING FIXTURES...YIELD TIME-COST SAVINGS



Wall Closet Fitting—horizontal, single type shown with connection for soil pipe.

Syphon Jet Closet Carrier Face Plate with universal adjustable fixture bolts and corrosion resistant adjustable coupling.

Exploded view of Zurn Wall Closet Fitting for syphon jet closet left-hand, horizontal, for soil pipe connections. Also available for threaded pipe connection.

Pat. and Pat. Pend.

Zurn Horizontal Adjustable System for wall-type fixtures roughed-in in public utility building in city in northwestern United States.

THE WAY
PERFECT ALIGNMENT
IN ALL 3 DIRECTIONS
Obtained with Exclusive Adjustment Features of Zurn Wall Closet Fittings And Carriers... For The Support of All Types And Makes of Wall Type Fixtures
Permanent horizontal alignment of each fixture with all others
Vertical adjustment of fixture to any required height from the floor
Exact adjustment of fixture at 90° to the wall

● The flexibility of a Zurn System for installing wall-type fixtures assures speed in assembly and accurate alignment in all three directions during installation; rigid water-tight connections insure minimum final adjustments when installing wall-type toilets; bulk of assembly can be precut in shop; unique waterway allowing a 4" vertical adjustment does away with numbered fittings.

A Zurn System is available for any make of wall-type plumbing fixture and can be assembled into an almost limitless variety of installations for all types of buildings, including apartments. A Zurn System includes everything for installing wall-type toilets up to where the horizontal drainage line connects with the stack, except the pipe. Installations are above the floor, behind the toilets, behind the wall; no delays waiting for other crafts. Write for free booklet, "You Can Build It and Maintain It for Less A NEW WAY."

ZURN

PLUMBING DIVISION PRODUCTS INCLUDE EVERYTHING FOR DRAINAGE SYSTEMS FROM ROOF TO BASEMENT

Greaseptor
Area Floor Drain
Roof Drain with Internal Expansion Joint; High velocity drainage
One of several types of Zurn Carriers for wall-type urinals
Supremo Perfect Seal Floor Level Cleanout
Backwater Valve Non-fouling

Copyright 1953

Over 500,000 Wall-Type Fixtures Now Installed with ZURN SYSTEMS in Buildings of Every Type from Coast to Coast. Write for list of buildings having rest rooms with fixture-bare floors.

J. A. ZURN MFG CO.

PLUMBING DIVISION • ERIE, PA., U. S. A.

Sales Offices in All Principal Cities

In Canada: Canadian Zurn Engineering Ltd., Montreal, P.Q.

J. A. ZURN MFG. CO. • PLUMBING DIVISION • ERIE, PA., U. S. A.

Please send me the new Zurn booklet, "You Can Build It and Maintain It for Less A NEW WAY."

Name and Title _____

Company _____

Street _____

City and State _____

Please attach coupon to your business letterhead. Dept. H. V.

New Modular MULTI-VENT® concealed ceiling panels

COSTS NO MORE

than ordinary air diffusing systems!

Yes! That is the big news in commercial, institutional, and industrial air conditioning for 1953.

Now you can specify this superior low velocity pressure displacement type of air distribution for metal pan ceilings at the same or *lower* cost than the high velocity injection type.

This is possible because the new MODULAR PANELS are so extremely simple and rapid to install. They can be assembled and installed in a few seconds by hand without the use of tools —a tremendous saving in labor cost!

Distributing air by Multi-Vent's gentle pressure displacement assures perfectly even air motion, and exceptional uniformity and control of room temperatures. The total absence of strong air streams or blow eliminates all the usual sources of draft complaints and permits complete freedom in locating panels and in relocating partitions.

Write today for detailed literature.

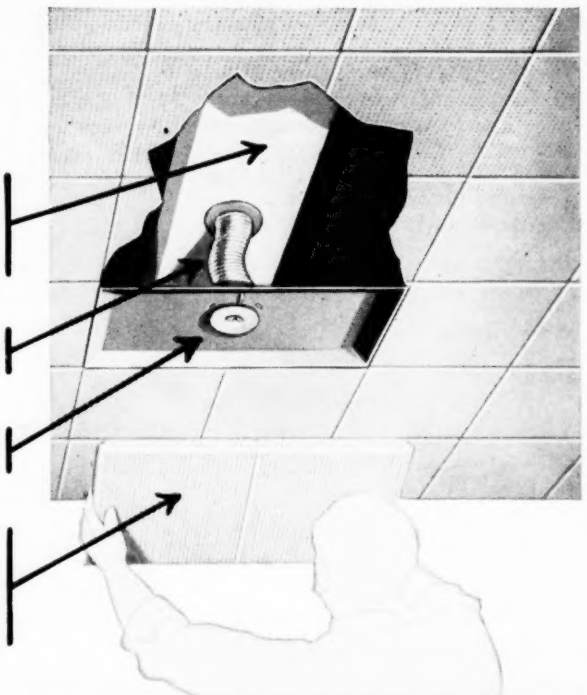
LABOR SAVING INSTALLATION FEATURES

■ **ADAPTABLE** . . . Duct can be shop built with 3-inch diameter openings at approximate panel locations. Duct work can be installed, flexible tubes with valve snapped in, and system balanced prior to and independent of ceiling erection. Panels can be located without regard to position of lighting fixtures and partitions.

■ **FLEXIBLE** . . . compressible tubing permits wide latitude in alignment, thus radically reduces installation cost by eliminating all need for time consuming close fitting sheet metal work.

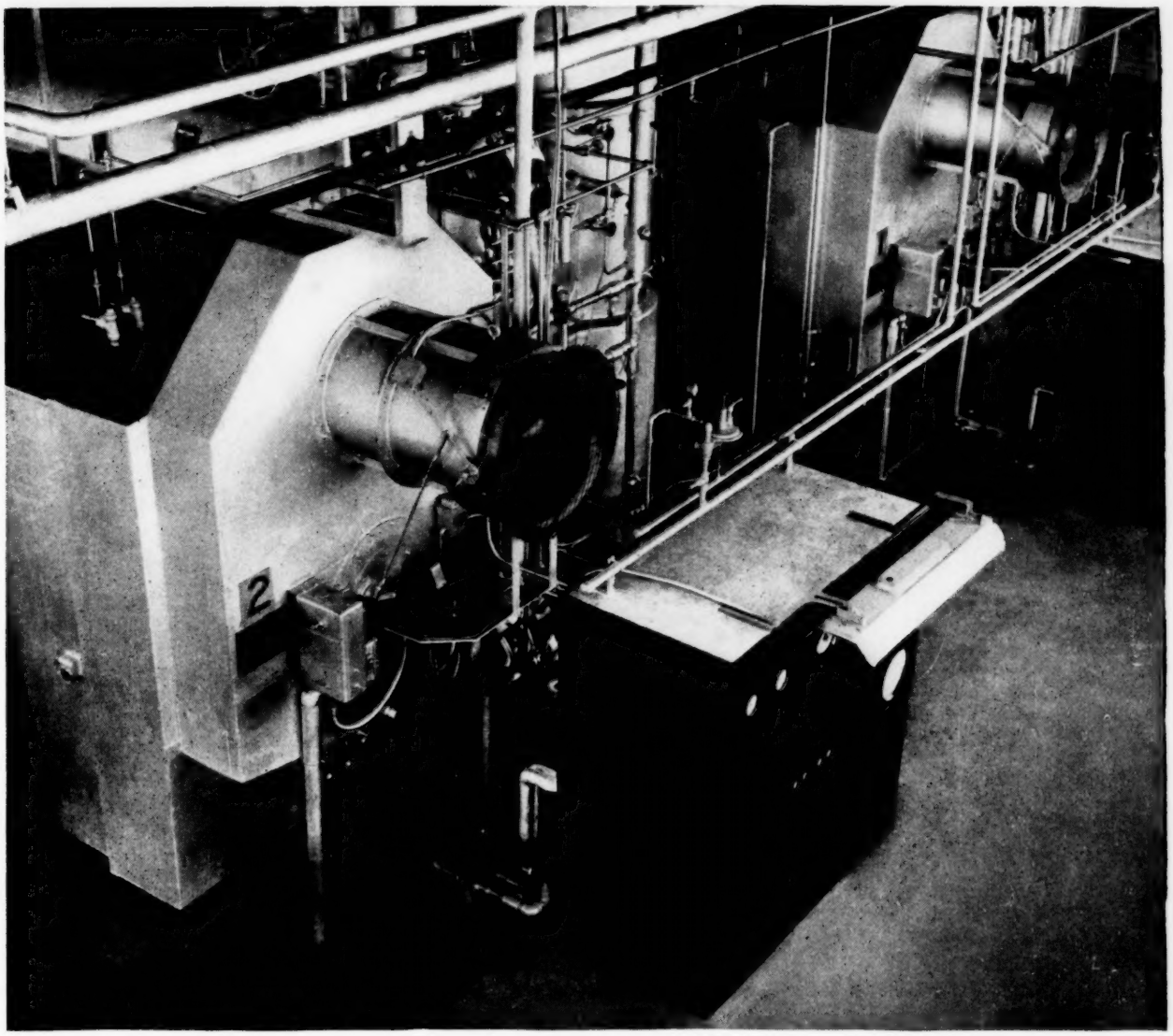
■ **ADJUSTABLE** . . . orifice valve can be simply set by wing nut for varied amount of air delivery. Individual panel adjustments do not disturb the overall balance of the system.

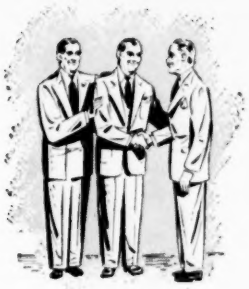
■ **COMPLETELY CONCEALED** . . . ANY STANDARD PERFORATED 12" x 24" ACOUSTICAL METAL CEILING PAN (supplied by the ceiling contractor) functions as the distribution plate for the MODULAR MULTI-VENT PANEL. The panel simply replaces the acoustical pad and nests snugly in the pan which snaps into ceiling tee runner, unhampered. Ceiling face is undisturbed.



MULTI-VENT DIVISION **THE PYLE-NATIONAL COMPANY**

Sales and Engineering Representatives in Principal Cities of United States and Canada 1374 North Kostner Ave. Chicago 51, Illinois





Popular Choice
for "Packaged" Steam

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

The shop-assembled B&W Integral-Furnace Boiler, Type FM, has gained industry-wide acceptance. Prominent companies in over 50 different industries, along with numerous utilities, educational institutions, hotels, hospitals, housing projects, office buildings, and government agencies have already selected this compact, self-contained steam generating unit for installations in 34 states, three U. S. territories and five foreign countries. Total steam capacity of units now in service and on order exceeds 5½ million pounds per hour. Nearly half of this capacity consists of multiple-unit applications of FM boilers instead of single larger-capacity units.

This recent B&W creation in low-cost steam generation is available in standardized sizes for loads of 2900 to 28,000 lb per hr at steam pressures to 250 psi.

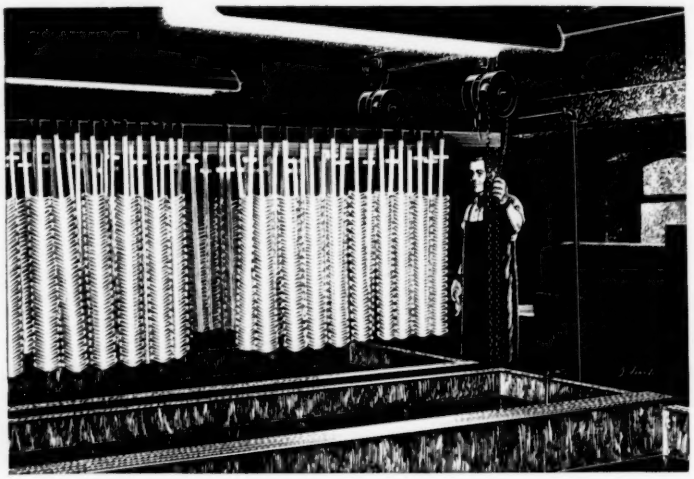
Send for Bulletin G-76 describing and illustrating the many cost-saving features of this popular boiler. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd St., New York 17, N. Y.

BABCOCK & WILCOX

G-573

Servel

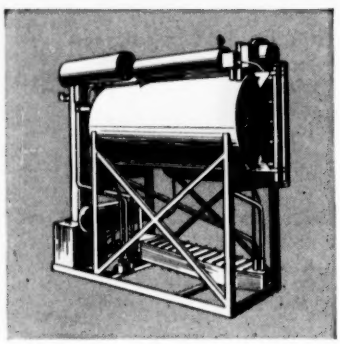
WELCOMES...and SOLVES



tough industrial cooling problems

When Colonial Alloys Company of Philadelphia decided to anodize aluminum products by the new and different Electrodizing Conservation or "EC" process, it faced the problem of maintaining proper temperature of the electrolytic bath solution.

To meet this essential requirement, Colonial Alloys chose a Servel 25-ton Water Chiller. Not only does this single Servel Air Conditioning unit maintain constant, controlled solution temperature, but it also provides office air conditioning, chilled water for experimental work, and cold drinking water.



The 25-ton Water Chiller used in the Servel installation at Colonial Alloys Company.

Colonial Alloys reports that the new "EC" process, in which Servel equipment plays such a leading part, has *increased aluminum anodizing production as much as five times, while cutting costs as much as 99%!*

This is one of many examples of how Servel Air Conditioning equipment benefits industry. Chances are, your problem can be solved in an equally satisfactory manner. Because Servel Air Conditioning *uses heat to produce cold*, operating economy is outstanding. It operates on gas, oil, steam or waste heat—whichever is the most economical fuel in your area. There are *no moving parts* to wear or cause vibration. And every Servel unit carries a complete *five-year warranty*.

★ ★ ★

Servel manufactures the world's finest air conditioning equipment to fit all air conditioning needs—residential, industrial, commercial—all-year or cooling alone. For complete information, clip and mail the coupon today.

Servel

the name to watch for great advances in—

AIR CONDITIONING ✓ REFRIGERATION

SERVEL, INC., DEPT. HV-4, Evansville 20, Indiana

I want to know more about industrial uses of Servel Air Conditioning.

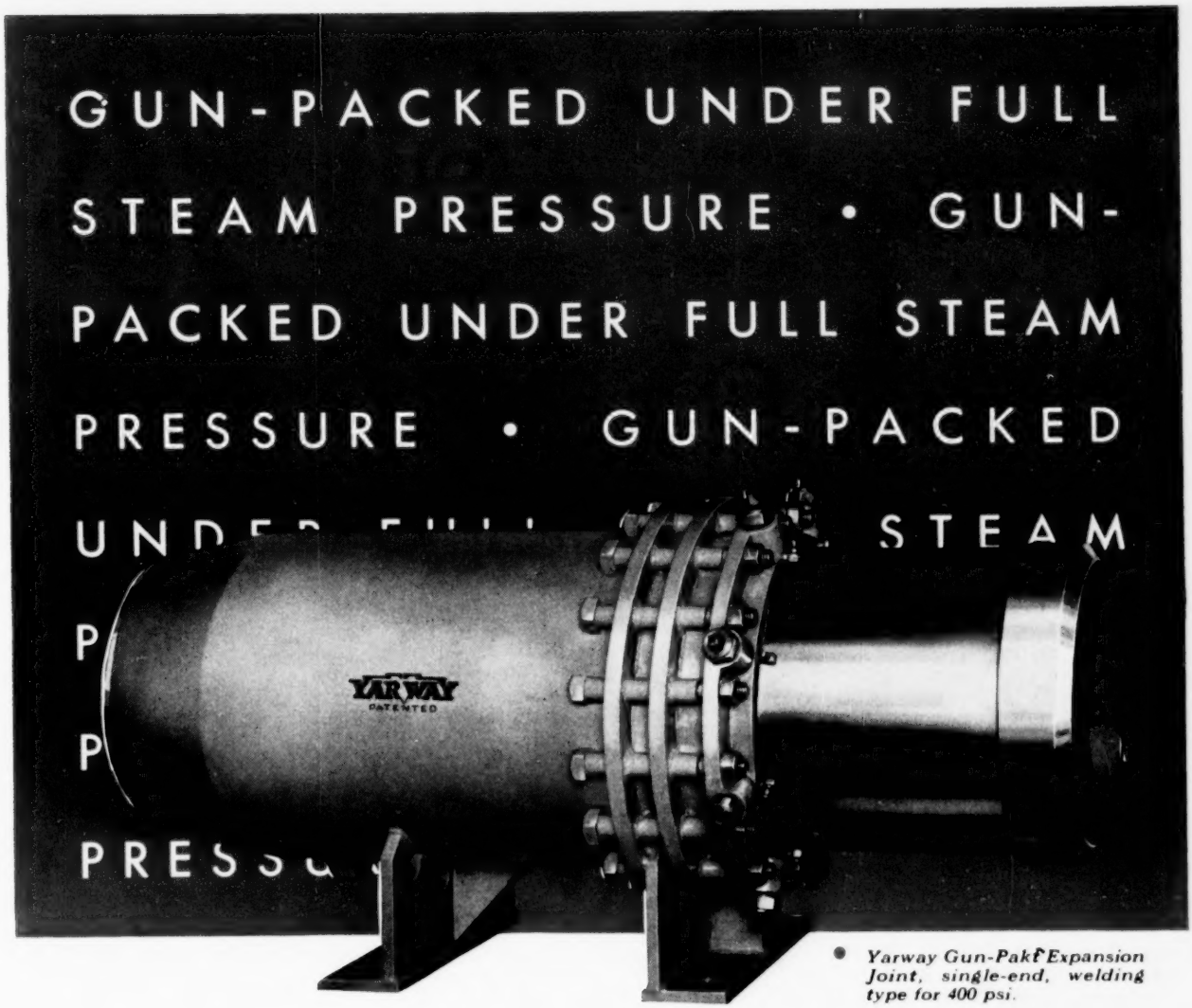
Name _____

Title _____

Company Name _____

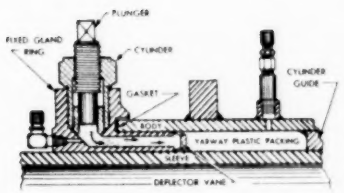
Address _____

City _____ State _____



• *Yarway Gun-Pakt Expansion Joint, single-end, welding type for 400 psi.*

BEHIND IT...AN ENGINEERING REASON



Cross-section of Gun-Pakt feature.

More large central station heating plants are using Yarway Gun-Pakt Expansion Joints in their steam distribution lines than any other type. This popularity of Yarway Gun-Pakt Expansion Joints in public utilities, institutions and industrial plants is due to the engineering reason behind them . . . *they are packed by a gun under full steam pressure.*

No shutdowns of steam lines, no production delays . . . you just insert a plug of Yarway plastic packing, twist a wrench, and the joint is tight, the job is done.

Such labor saving features, combined with impressive records of low maintenance requirements, make Yarway Gun-Pakt Joints a natural selection for your steam lines. Certainly you'll find them worth investigating.

Write for Yarway Expansion Joint Bulletin EJ-1912.

YARNALL-WARING COMPANY
104 Mermaid Avenue • Philadelphia 18, Pa.

YARWAY | ***gun-pakt expansion joints***

"I could see the corpsman kneeling over me. The blood plasma was running down through a tube into my arm and he said everything was going to be O.K. I was walking across an enemy mine field in Seoul when one exploded and a piece of shrapnel caught me in the leg.

" 'Got enough of that stuff?' I asked him, pointing to the blood. 'I guess we never have enough,' he said, 'but you can thank *somebody* for this pint.'

"How do you thank 'somebody' for blood? For saving your life? When I got back home, I discovered the answer at my local blood donor center. There's only *one* way to say thanks—by giving some of your own blood."

"How do you thank 'somebody' for Blood?"

Yes, all kinds of people give blood—for all kinds of reasons. But whatever *your* reason for giving blood, this you can be sure of: Whether your blood goes to a combat area, a local hospital, or for Civil Defense needs—this priceless, painless gift will some day save an American life!

Business Executives!

✓Check These Questions!

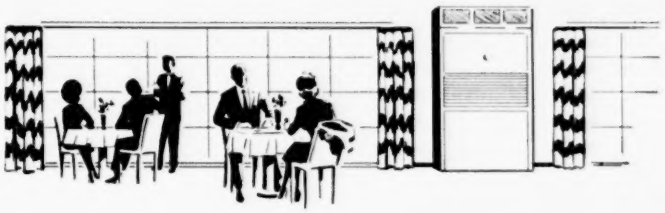
If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ☐ Have you given your employees time off to make blood donations?
- ☐ Do you have a Blood Donor Honor Roll in your company?
- ☐ Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?
- ☐ Have you arranged to have a Bloodmobile make regular visits?
- ☐ Has your management endorsed the local Blood Donor Program?
- ☐ Have you informed employees of your company's plan of co-operation?
- ☐ Was this information given through Plant Bulletin or House Magazine?
- ☐ Has your company given any recognition to donors?
- ☐ Have you conducted a Donor Pledge Campaign in your company?

Remember, as long as a *single* pint of blood may mean the difference between life and death for *any* American . . . the need for blood is *urgent!*

Give Blood Now—Call Your Red Cross Today!

National Blood Program



THERE'S A "STOUT HEART" IN THIS AIR CONDITIONER

The compressor is often called the "heart" of an air conditioner. And when you sell a Chrysler Airtemp "Packaged" Air Conditioner, your customer is getting a compressor that's unsurpassed. Here are some of the reasons why:

LONG EFFICIENT LIFE

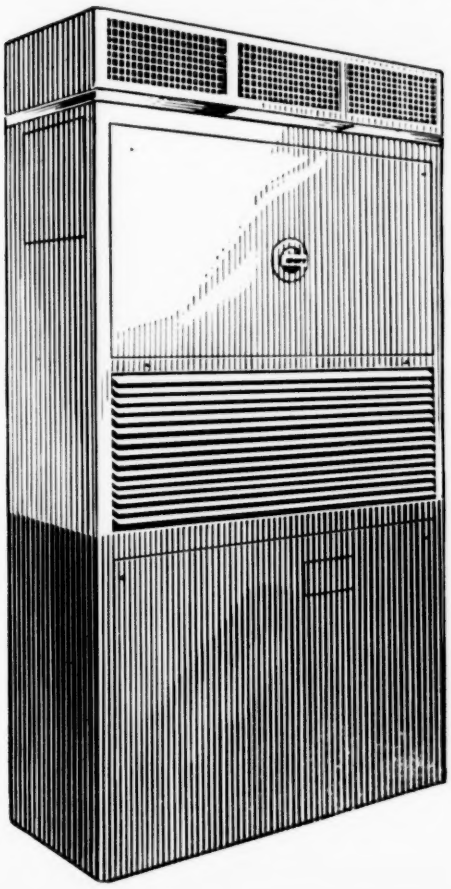
The precise machining and honing of vital moving parts cuts wear way down. Positive pressure lubrication reduces wear, too. The unique suction and discharge valve design gives top, sustained efficiency at high compressor speeds.

QUIET OPERATION

Vibration is reduced to a minimum because the radial compressor design permits perfect balance regardless of the number of cylinders.

Add one more important feature—machined, assembled and tested in a windowless, air conditioned factory, and you can easily see why the word "unsurpassed" in the first paragraph is not an idle claim—it's a fact!

Comfort Zone FOR PROFIT



"Packaged" Air Conditioners
Six models from 2 to 15 H.P. capacity. Meets every cooling need.

Guaranteed by Good Housekeeping

Chrysler Airtemp

HEATING • AIR CONDITIONING
***for* HOMES, BUSINESS, INDUSTRY**
Airtemp Division, Chrysler Corporation, Dayton 1, Ohio

H&V-4-53

Airtemp Division, Chrysler Corporation
P.O. Box 1037, Dayton 1, Ohio

Please send full details on the Chrysler Airtemp Comfort Zone "Packaged" Air Conditioning proposition.

Name _____

Address _____ Phone _____

City _____ Zone ____ State _____

D.I.P.
FIRST IN THE FIELD OF PRE-SEALED INSULATED PIPING FOR STEAM HOT WATER REFRIGERANTS
Traffic has been running over this steam line for ten years without damaging the Durant Insulated Pipe.
1678

D.I.P. was installed here in less than 8 hours

For a New England railroad, over 120 feet of 6 inch steam line had to be run under eight tracks as quickly as possible—without delaying main line trains. A trench was opened under the tracks, limited in width by the distance between ties. The Durant pre-fabricated units were welded together, joints covered and sealed, and the elongated section was jacked through under the rails. Work was executed in less than eight hours. The only fill over the D. I. P. was the customary thickness of broken stone ballast. Traffic has been running over this steam line for more than ten years without damaging the D. I. P. units.

The cost of installing D. I. P. is extremely low because this conduit can be laid on the bottom of a graded open trench. No external casing-welding, no drains, tile, concrete tunnels, special tools or equipment are needed. Use of expansion loops, ells and tees eliminate manholes, expansion joints and other features requiring maintenance. For above-ground installation, any type of pipe support can be used.

D. I. P. is the *only* pre-sealed insulated conduit not dependent on a metal jacket for protection from moisture and corrosion. A 1" layer of asphalt is the waterproofing protection. Steam pressures up to 1000 psi.

Write today for catalog 4-G, for engineering service, or a representative's call.

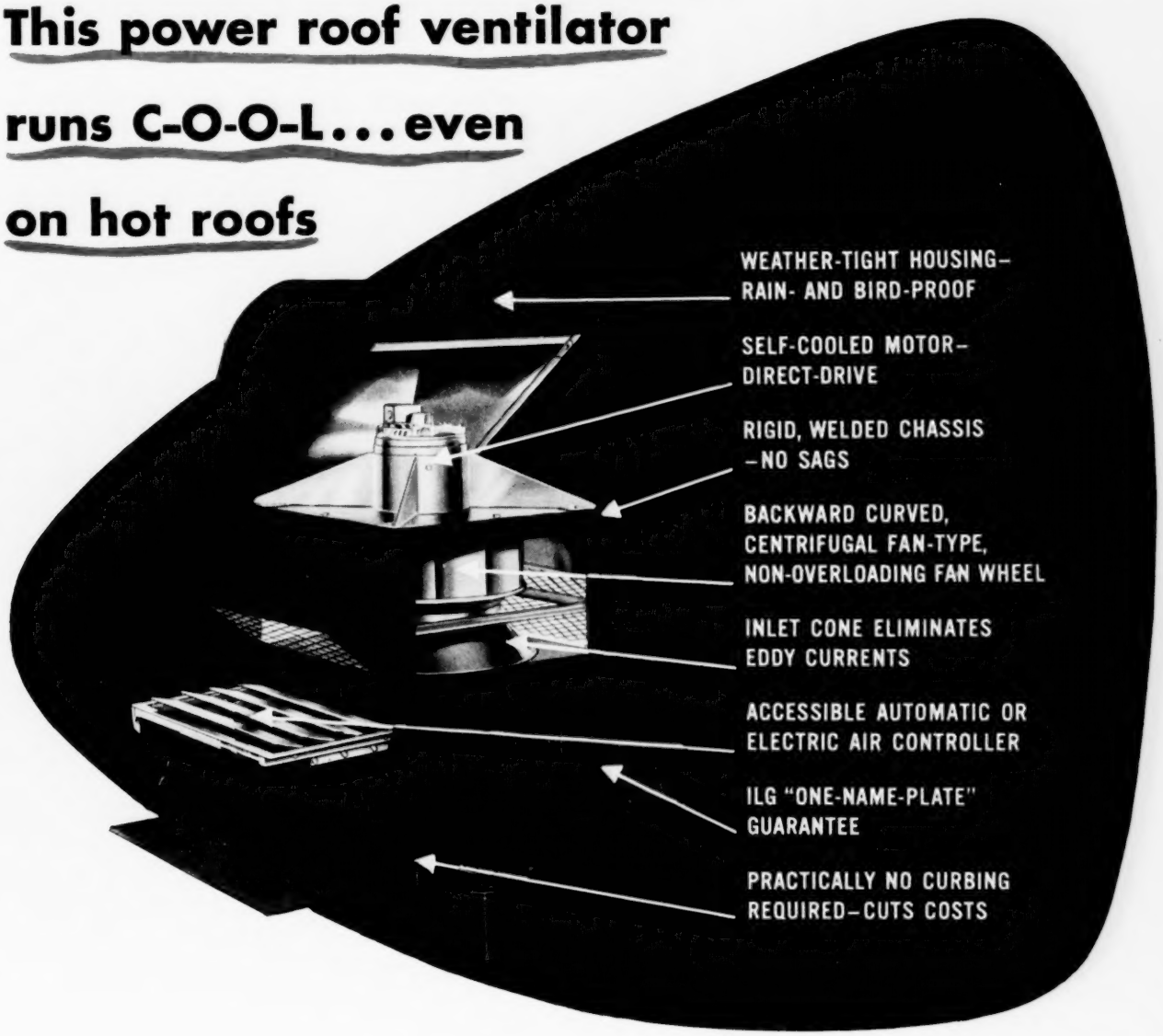
Representatives in Principal Cities

PRE SEALED ®

Western Division: **DURANT INSULATED PIPE COMPANY**
WARREN WAY AND BAY ROAD, PALO ALTO, CALIFORNIA

Eastern Division: **DURANT INTERNATIONAL CORPORATION**
WILLIAMSTOWN, NEW JERSEY

This power roof ventilator runs C-O-O-L... even on hot roofs



Most successful ventilator in ILG's 47-year history!

• ILG can point to dozens of pioneering developments since 1906 for the ventilating and heating industries. But none of these prior contributions can approach the immediate acceptance and continuously increasing use of these new Centrifugal-type Power Roof Ventilators. In a matter of months these new units have found their way into the specifications and onto the roofs of important buildings throughout the nation. Today you will see them on hospitals, schools, industrial and governmental buildings everywhere. They answer the demand for "package" ventilators, easily installed, complete with desirable air-handling features, and with all parts quickly accessible. If you do not have latest data on these powerful roof ventilators for use on vertical flues or duct systems, take action today. Call our nearby Branch Office (consult classified directory) or send coupon now.

ILG knows ventilation!

ILG ELECTRIC VENTILATING CO.
2850 North Crawford Ave., Chicago 41, Illinois
Offices in more than 50 Principal Cities

Free! New engineering data bulletin No. 1902 gives you the complete story—features, sizes, capacities, dimensions. Send coupon now!

☐ Send free bulletin No. 1902

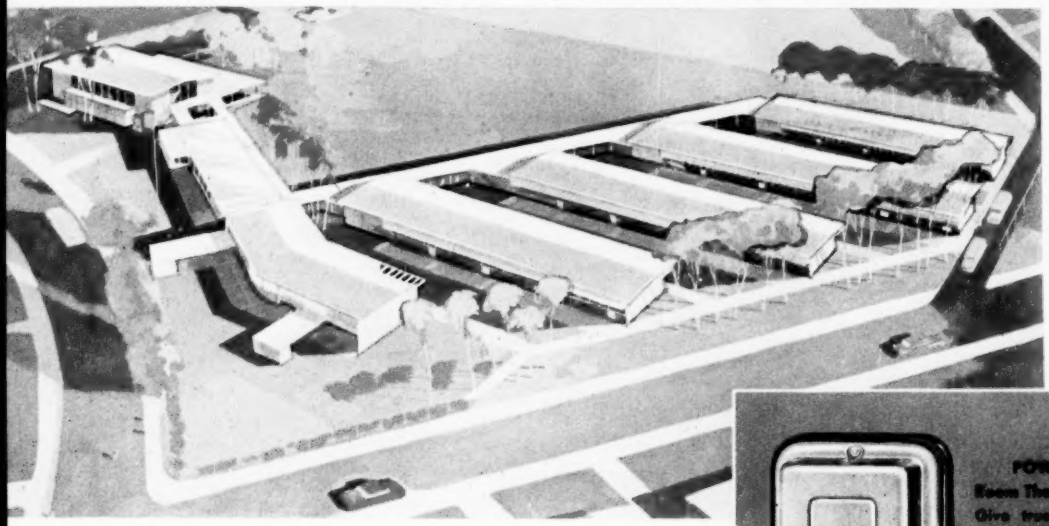
Firm Name _____

Individual _____ *Title* _____

Address _____

City _____ *State* _____

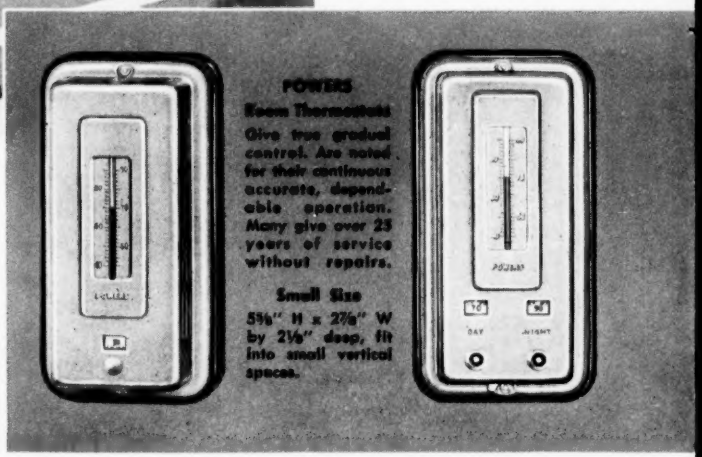
THOMAS B. MOFFITT SCHOOL, NORWALK, CALIFORNIA



Architects
KISTNER, WRIGHT and WRIGHT
(Successors to Kistner, Curtis and Wright)

Chief Mechanical Engineer
CHESTER D. WALZ

Heating Contractor
DAVIS PIPING CO., Whittier, Calif.


POWERS
Room Thermostats
Give true gradual control. Are noted for their continuous accurate, dependable operation. Many give over 25 years of service without repairs.
Small Size
5⅝" H x 2⅞" W by 2⅛" deep, fit into small vertical spaces.

POWERS

Pneumatic Systems of TEMPERATURE CONTROL

Installed in These Modern Elementary Schools

IN 1978 – these and hundreds of other schools on their silver anniversary very likely will award "A's" to Powers "for dependable temperature control with a minimum of maintenance."

25 to 40 years of reliable low-maintenance-cost service is frequently reported by Powers users. Some installations made in 1901 to 1910 are still in operation and giving good control. Recent design improvements in Powers equipment will not only give better control but an even longer life expectancy . . . greater comfort and lower operating costs. When you want help in selecting the type of temperature control best suited for your requirements—contact Powers nearest office. There's no obligation.

Established in 1891 • THE POWERS REGULATOR COMPANY • SKOKIE, ILL. • Offices in Over 50 Cities

(b5)

MODERN CONTROLS FOR MODERN SCHOOLS

POWERS NO-PAK PACKLESS VALVES

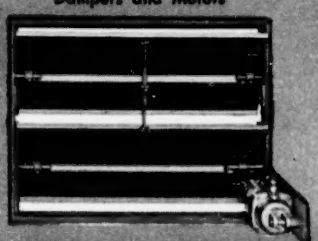
. . . require no maintenance of packing. They prevent leakage of water or steam

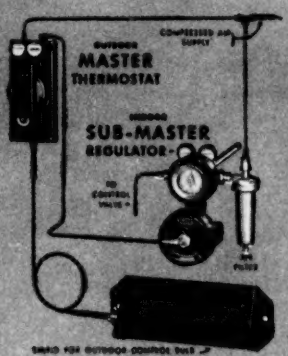
VARIOUS TYPES AND SIZES FOR ALL REQUIREMENTS

Powerful Small Top Valve, with angle or straight-way union; Reverse Flow Angle with double female unions; also flared ends and screwed end bodies.

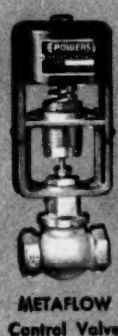
Airstream Thermostat for Unit Ventilators

Complete line of modern Dampers and Motors





MASTROL System for controlling forced hot water heating



METAFLOW Control Valve

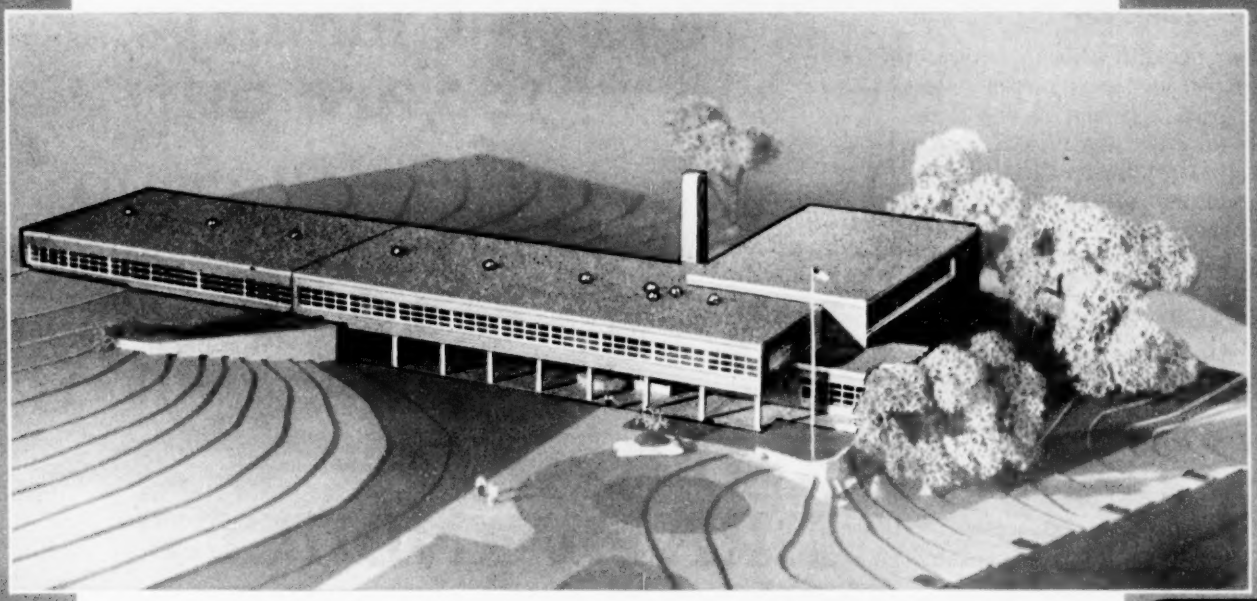
Right: FLOWRITE Neoprene Diaphragm Control Valve

Architects: ADK and TODD
Consulting Engineers: ROBSON & WOESE
Contractor: W. A. McCORMICK

Above: HILTON CENTRAL SCHOOL, HILTON, NEW YORK

POWERS

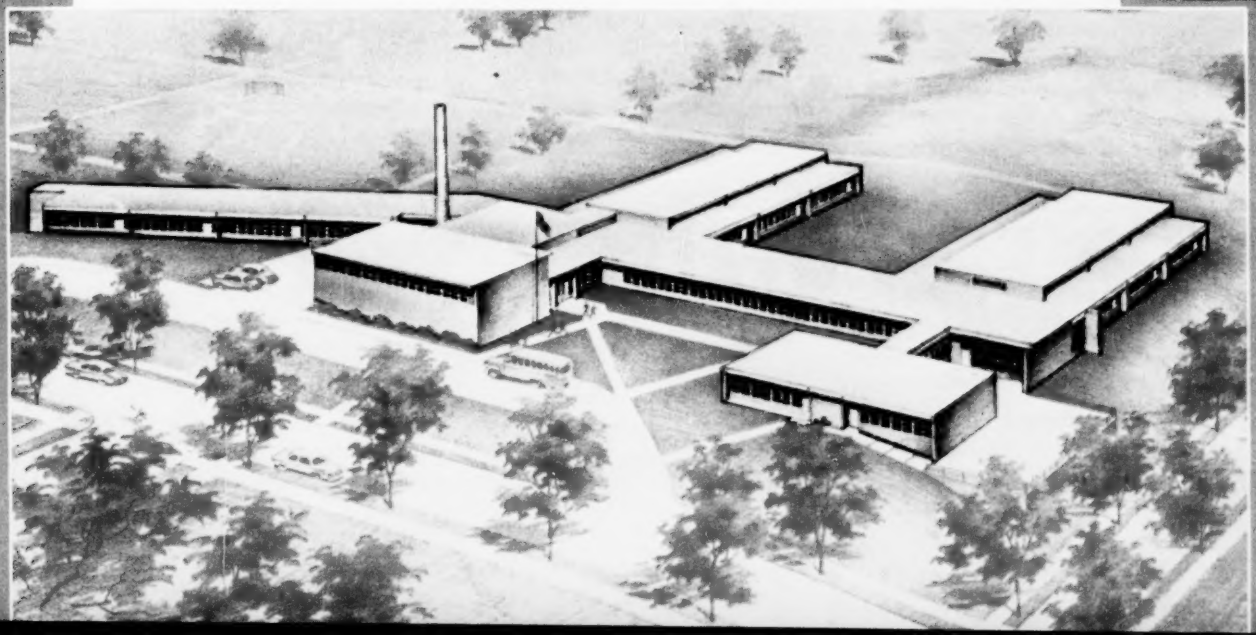
Below: LEE ELEMENTARY SCHOOL, MANHATTAN, KANSAS



Architects and Engineers
E. O. WOLFENBARGER & ASSOCIATES
Contractor: WOODHULL PLUMBING CO.

Below: MAUDE ARMITAGE ELEMENTARY SCHOOL, MINNEAPOLIS, MINNESOTA

POWERS

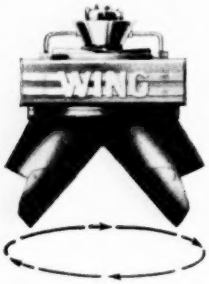


Architects and Engineers: MAGNEY, TUSLER and SETTER and PERKINS & WILL
Contractor: H. R. NICHOLS PLBG. & HTG. CO.

HEAT THAT MOVES AROUND

with the WING REVOLVING HEATER

The fact that the discharge outlets of Wing Revolving Heaters keep the heated air in gentle, constant motion is the reason firms like the Budd Company have installed Wing Revolving Heaters in their plants, both at Philadelphia, and at the plant shown in the photograph above at Gary, Indiana. Big blanking and forming presses make a natural barrier to ordinary heating systems, but

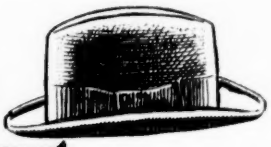


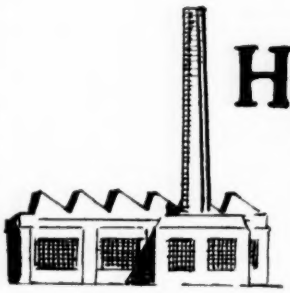
not to the moving streams of heated air from the Wing Revolving Heaters, even suspended, as they must be, far above the floor to clear the cranes. Uniform distribution is accomplished because the moving streams of heated air sweep slowly around through 360 degrees, covering successively every direction; thus every part of the plant is kept at a comfortable temperature. And in Summer, with the steam turned off and fans on, the revolving discharge outlets create a sensation of pleasing coolness that is very refreshing even on the hottest days.

Write for a copy of Bulletin HR-6 to L. J. Wing Mfg. Co., 158 Vreeland Mills Road, Linden, New Jersey.

High Hats are out of date

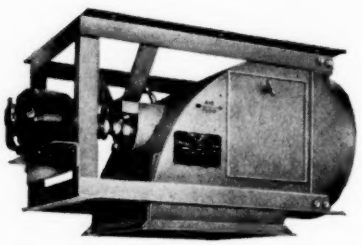
now— it's the Homburg





High Chimneys, too, are out of date

now— it's the WING DRAFT INDUCER

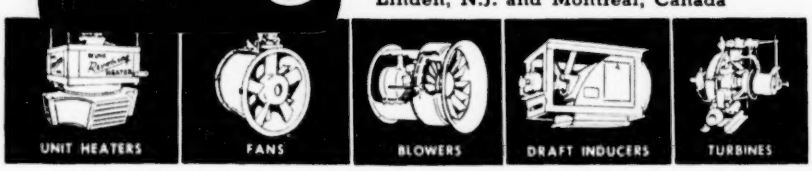


Why? Because your heating plant can have positive, adequate, uniform draft without the need for tall, unsightly, expensive stacks. Unlike variable chimney draft, the Wing Draft Inducer gives perfect motorized draft in any weather. It cuts fuel costs by giving higher CO_2's. Smoking is reduced or eliminated. The capacity of your boiler plant is increased.

Write for a copy of Bulletin I-52

Wing

L. J. Wing Mfg. Co.
158 Vreeland Mills Road
Linden, New Jersey
Factories:
Linden, N.J. and Montreal, Canada



ONE OF THE MOST COMPLETE LINES IN THE INDUSTRY

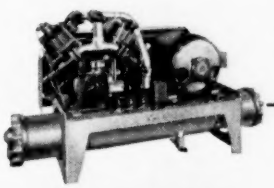
NEW improved

Curtis CONDENSING UNITS at NEW, LOW PRICES

All with these Famous Curtis Features:

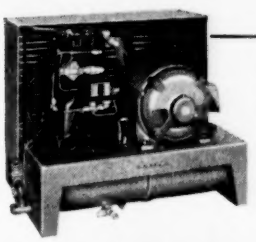
- TIMKEN TAPERED ROLLER BEARINGS
- POSITIVE LUBRICATION
- OIL LEVEL SIGHT GLASS
- SLOW SPEED OPERATION FOR LONG LIFE AND HIGH EFFICIENCY

Plus a complete line of packaged units in six sizes 2-3-5-7½-10-15-H.P.



WATER COOLED CONDENSING UNIT

Low, Regular and High Temp., from ⅓ H.P. to 50 H.P.

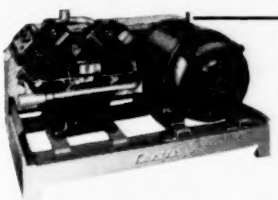


AIR COOLED CONDENSING UNIT

Self-contained, remote, truck type, from ¼ H.P. to 3 H.P.

COMBINATION AIR AND WATER COOLED CONDENSING UNIT

Plenty of reserve capacity for extreme hot weather. Operates primarily as air cooled unit with shell and coil condenser as auxiliary in case of overload. From ⅓ H.P. to 3 H.P.



COMPRESSOR UNITS

For use with evaporative condensers, low temperature cooling, processing and air conditioning installations, from 3 H.P. to 50 H.P.

For Immediate Information — **Use This Coupon**

CURTIS REFRIGERATING MACHINE DIVISION
of Curtis Manufacturing Company
1999 KIENLEN AVENUE, ST. LOUIS 20, MISSOURI

I am interested in direct factory franchise. Send complete details.

COMPANY NAME_____

STREET_____

CITY_____ ZONE____ STATE_____

SIGNED_____

The Cook Who Discovered the Recipe...

Almost 50 years ago, C. A. Dunham Company introduced the first successful fluid-filled thermostatic radiator trap . . . and steam heating became practical, economical, popular.

Since that time, Dunham has developed a complete line of heating specialties: float and thermostatic traps, inverted bucket traps, radiator valves, elbows, strainers, fittings.

Today, in hundreds of thousands of installations from coast to coast, these top quality products are delivering the dependable, long-lasting, low maintenance service so essential to efficient heating systems. Their performance is proof, customers say, that "no one can bake a cake as well as the cook who discovered the recipe."

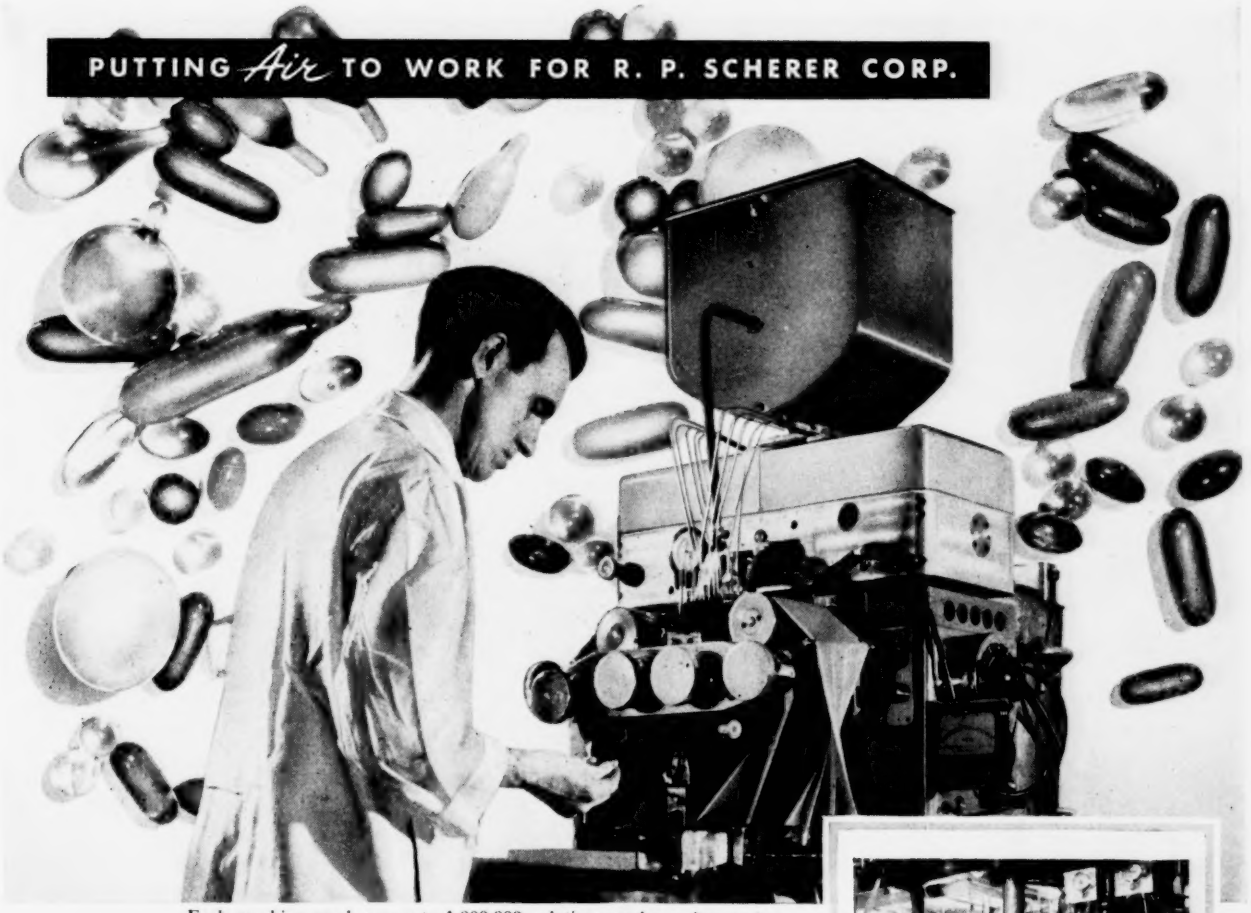
Heating Specialties
Bulletin 1501-16
contains complete data—special features, applications, capacities, etc. Please write for your free copy to
C. A. Dunham Co., 400 W. Madison St., Chicago 6, Ill.

DUNHAM HEATING SPECIALTIES

DUNHAM 1903-1953

Quality first for fifty years

PUTTING *Air* TO WORK FOR R. P. SCHERER CORP.



Each machine produces up to 1,000,000 gelatin capsules a day, and controlled atmosphere is a "must" to assure dependable production schedules.

KEEPING CAPSULES IN CADENCE FOR

9 TROUBLE-FREE YEARS

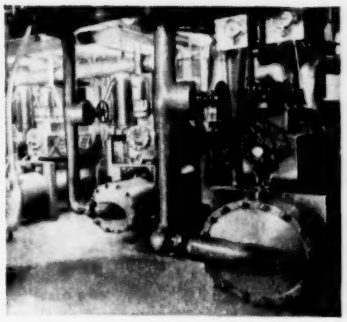
Capsules . . . capsules . . . capsules—name your size, shape and color! They turn out millions a day filled with anything from vitamins and medicine to lighter fluid and insecticide here at R. P. Scherer Corp. in Detroit. But watch out for moisture-laden air. Until they're dried, these soft gelatin containers are regular little water magnets.

The answer? Rigid, unvarying control of temperature and humidity 24 hours a day, seven days a week! It takes really dependable equipment for these unusual requirements. That's why Westinghouse Air Conditioning was selected.*

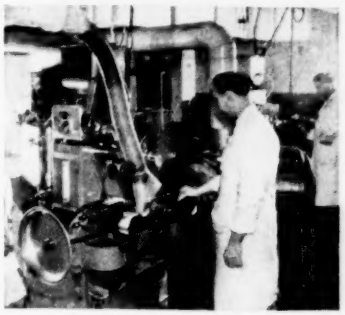
The result? For nine years their Westinghouse system has operated continuously without a single shutdown caused by mechanical failure. This full-time service equals *forty years* of normal service on an equivalent comfort air conditioning system.

Whatever your process involves in the way of a controlled climate, we can help you *put air to work* with air conditioning, air cleaning and air handling equipment. Call the Westinghouse Air Conditioning Distributor listed in the Yellow Pages, or write to Westinghouse Electric Corp., Air Conditioning Division, Hyde Park, Boston 36, Mass.

*Installed by Mechanical Heat & Cold, Inc., Detroit, Michigan



Heads, end bells and side plates have not once been removed since installation in 1942 despite a continuous service record totalling 54,000 hours.



Controlled air supplied to each capsulating machine insures the absolute uniformity of product that is required.

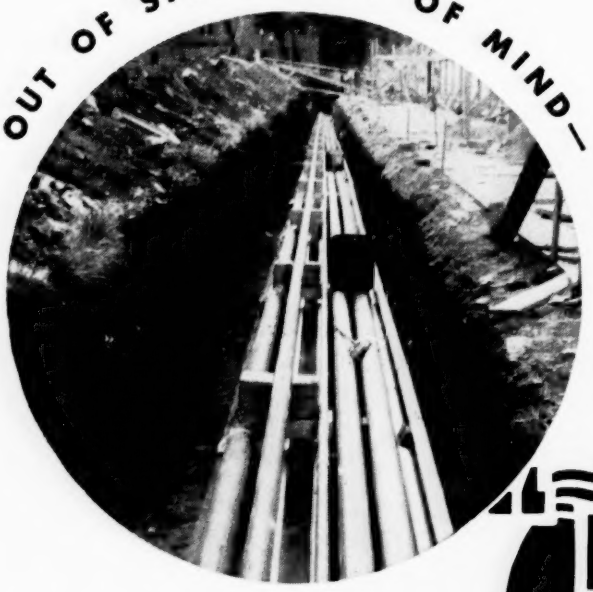
YOU CAN BE SURE...IF IT'S

Westinghouse

J-80253

AIR CONDITIONING

OUT OF SIGHT—OUT OF MIND—



Conduit containing 10 pipes in typical installation. Contains no joints, no voids. Z-Crete is as permanent as the earth itself!

Permanently!

...when underground heated piping is insulated

with

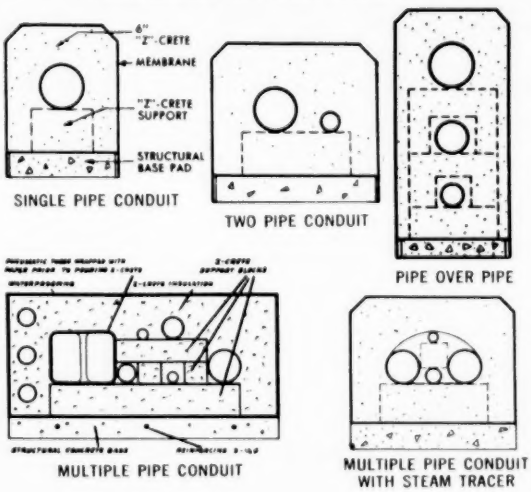
"Z" crete®

Only Z-Crete, the Modern Monolithic Insulation, Makes It Possible to Insulate a Job and Forget It!

Z-Crete, the lightweight, resilient, insulating concrete specially designed for underground heated piping *you can install and forget!* It's as permanent as the earth itself.

Z-Crete's stability and high water resistance make it a good protector against pipe corrosion, as well as an excellent insulator. It is poured directly and monolithically around the piping, eliminating joints or voids. Fireproof, rotproof and verminproof, Z-Crete serves a dual purpose—the insulating concrete is both the structural conduit and the insulation. Any number, size, or arrangement of pipes can be designed into a Z-Crete conduit. Inquire today . . . there's an experienced, licensed applicator near you!

USE Z-CRETE FOR ANY HEATED UNDERGROUND SYSTEM



SINGLE PIPE CONDUIT

TWO PIPE CONDUIT

PIPE OVER PIPE

MULTIPLE PIPE CONDUIT

MULTIPLE PIPE CONDUIT WITH STEAM TRACER

"Z" crete® DIVISION

ZONOLITE COMPANY

135 South La Salle Street • Chicago 3, Illinois

Z-Crete is furnished and installed only by licensed applicators of Zonolite Company under U. S. Patent No. 2355966—Canadian Patent No. 439356

Write for FREE Booklet

Z-CRETE DIVISION,
ZONOLITE COMPANY
Dept. HV-43, 135 S. LaSalle St.
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Please rush FREE Z-Crete Booklet with full details and specifications about this easier, better insulation for underground heated piping.

Name.....

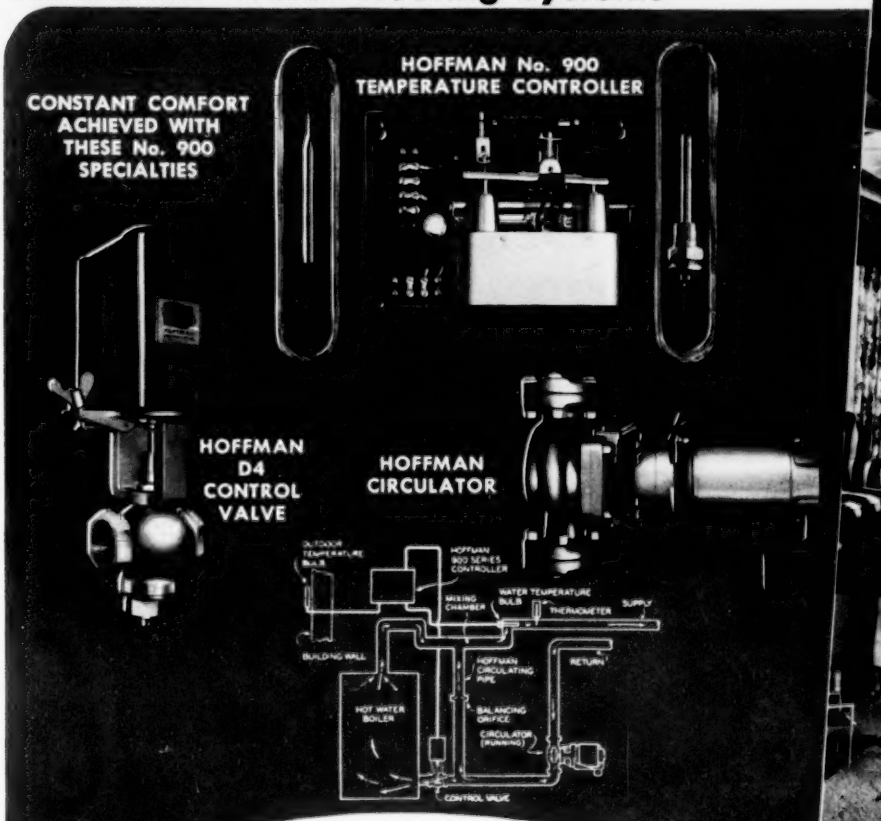
Company.....

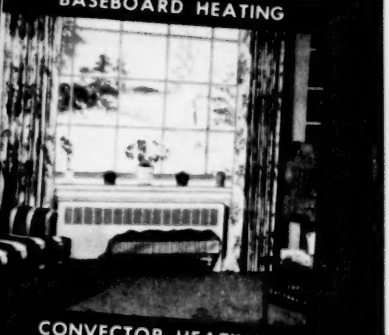
Address.....

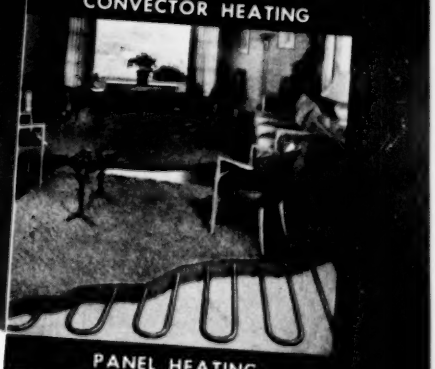
City.....Zone.....State.....

HOFFMAN TEMPERATURE CONTROLLER

For CONVECTOR, BASEBOARD and PANEL Forced Hot Water Heating Systems







CONTINUOUSLY CIRCULATED HOT WATER • • •

AUTOMATICALLY MAINTAINS UNIFORM COMFORT REGARDLESS OF WEATHER CHANGES

The Hoffman Temperature Controller is based on the fact that for every Outdoor Temperature there is a corresponding Supply-water Temperature, which must be *automatically maintained* in the heating units. The correct Supply-water Temperature, in the case of a panel heating system, or the output per sq. ft. EDR in the case of other forms of radiation, must be specified by the Architect or Engineer for *one Outdoor Temperature*. The Controller then *automatically* adjusts the Water Temperatures to balance any other outdoor conditions encountered. The following table illustrates several sets of conditions for a panel heating system.

Architect or Engineer to Specify			Factory Sets Controller		Controller Automatically Furnishes Supply Water at Temperatures Correct for Any Outdoor Temp. as Listed Below				
					Outdoor Temperature °F.				
Design Temp. °F.	Supply Water °F.	Room Temp. °F.	Scale No	Supply Water °F. at Outdoor 32 °F.	−10	0	+10	+30	+50
					SUPPLY WATER TEMPERATURE °F.				
−10	150	70	11	108	150	140	130	110	90
0	150	70	13½	114	—	150	139	116	94
+10	140	70	14	115	—	—	140	117	94
−10	140	70	9	104	140	132	123	106	88
−10	160	70	13	113	160	147	137	115	92

When the outdoor temperature reaches 65°F., the Circulator automatically stops. The 65° factory setting was chosen because it is the basis for calculating degree days. If a different cut-out temperature is desired, it can be easily adjusted to individual requirements. Occasionally the actual heat loss differs from the calculated loss due perhaps to changes in construction. The Temperature Controller can be easily re-adjusted after installation according to simple, definite instructions furnished by the factory. Technical literature describing the No. 900 Controller and sample specifications, gladly furnished on request.

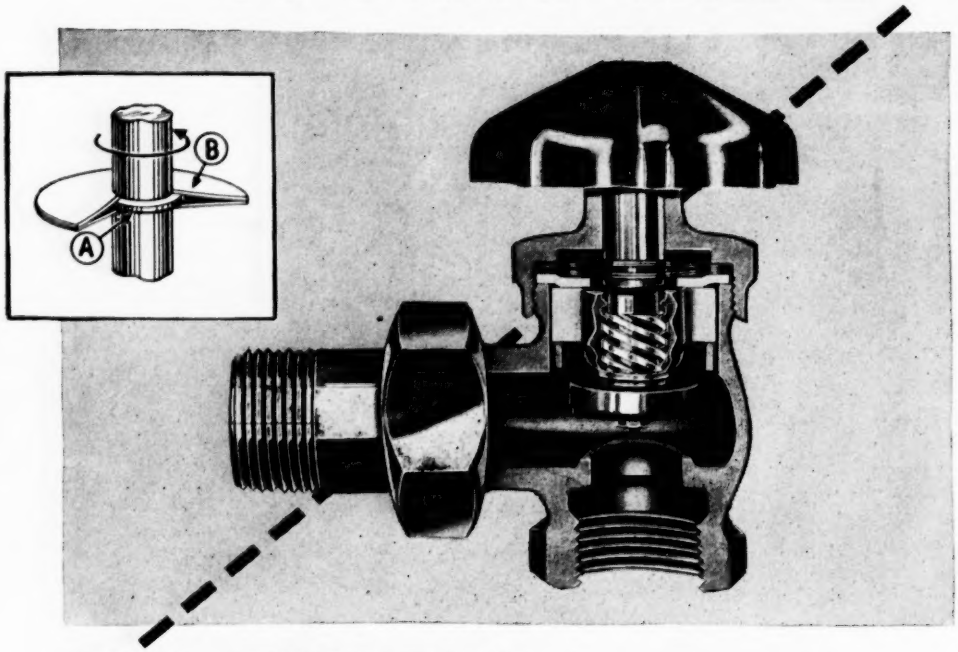
Applicable to every Type of Building Zoning Easily Accomplished

• • • PIONEERED BY HOFFMAN

HOFFMAN SPECIALTY MFG. CORP. • 1001 York Street, Indianapolis 7, Indiana

Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensation Pumps — Sold by Leading Wholesalers of Heating and Plumbing Equipment

A Valve that is



PACKLESS in fact

. . . not just packless in name

When the job calls for the kind of valve that will stand up across the years —when it calls for a valve that is packless in the full meaning of the word— then, no matter how far you look, you'll find in the Marsh Packless the only valve that completely fills the bill.

In fact, many users consider this the only valve that is packless in fact as well as in name, and they have a good reason for this. There is a difference between pack less and packless! The diagram tells the story of Marsh truly packless construction. A collar (A) is machined on the valve stem. The stainless spring steel wafers (B) press against this collar to form a tight annular seal This, you see, is a metal-to-metal seal—*permanently* leakproof.

And this better construction is typical of the quality and refinement found throughout the Marsh Packless Valve—in the swivel, self-seating, self-cleaning disc—in the excellent proportioning, machining, workmanship and finish.

Packed valves can and do "blow out", scalding or burning the operator. This danger is avoided when you use the Marsh Packless. It is a valve you can rely on for any service up to 100 lbs. Furnished in a wide range of patterns including graduated and extended stem types, the Marsh Packless Valve is widely used for steam and hot water heating systems, coffee urns, steam kettles, sterilizers, ovens and similar services. Ask our representative or engineering department for facts.

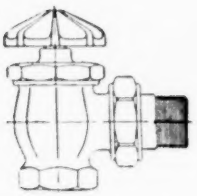
MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*

Dept. U, Skokie, Ill.

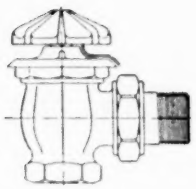
MANUFACTURERS OF GAUGES • THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES

MARSH SINCE 1865

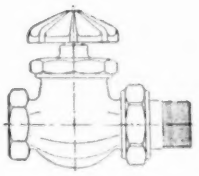
Quality Heating Specialties



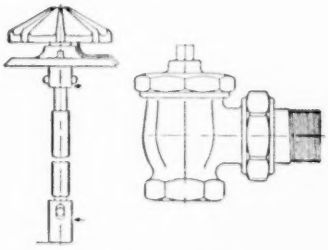
Wheel Angle



Wheel Angle Graduated



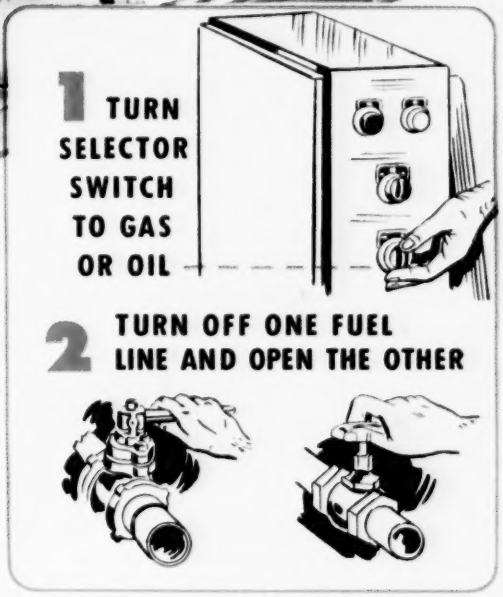
Globe



Extension stem

NOW... interchange Gas and Oil firing in *10 seconds*

Modern Cleaver-Brooks Model LR Steam Boiler Equipped with Exclusive Cleaver-Brooks "10-second conversion" Combination GAS and/or OIL Burner



TWO, simple motions eliminate time-consuming change-over

Now you can use oil or gas at the flick of a switch! This exclusive new Cleaver-Brooks development permits changeover from oil to gas or vice versa in only 10 seconds.

That's because the Cleaver-Brooks Combination Gas and/or Oil Fired Boiler operates on gas *with the oil burner in place*. Simply flipping a selector switch on the control panel to either gas *or* oil sets the proper circuit in action. Turning the convenient fuel supply valves completes the entire changeover — and in 10 seconds or less!

To gas users in all parts of the country — and in particular areas where local requirements demand immediate changeover — this exceptional fuel flexibility can be an important factor in determining your overall operating economy.

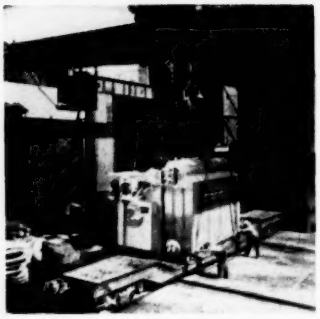
Ten-second conversion, like 4-pass construction, self-contained design, guaranteed 80% efficiency, is another "plus" feature pioneered by Cleaver-Brooks. It demonstrates Cleaver-Brooks' continuing effort to bring steam users even greater flexibility and reduced operating costs.

If you are considering simplifying your present boiler plant, remember Cleaver-Brooks Combination GAS and/or OIL Fired Boilers. Sizes 15 to 500 h.p. — 15 to 250 p.s.i. Write for complete facts.

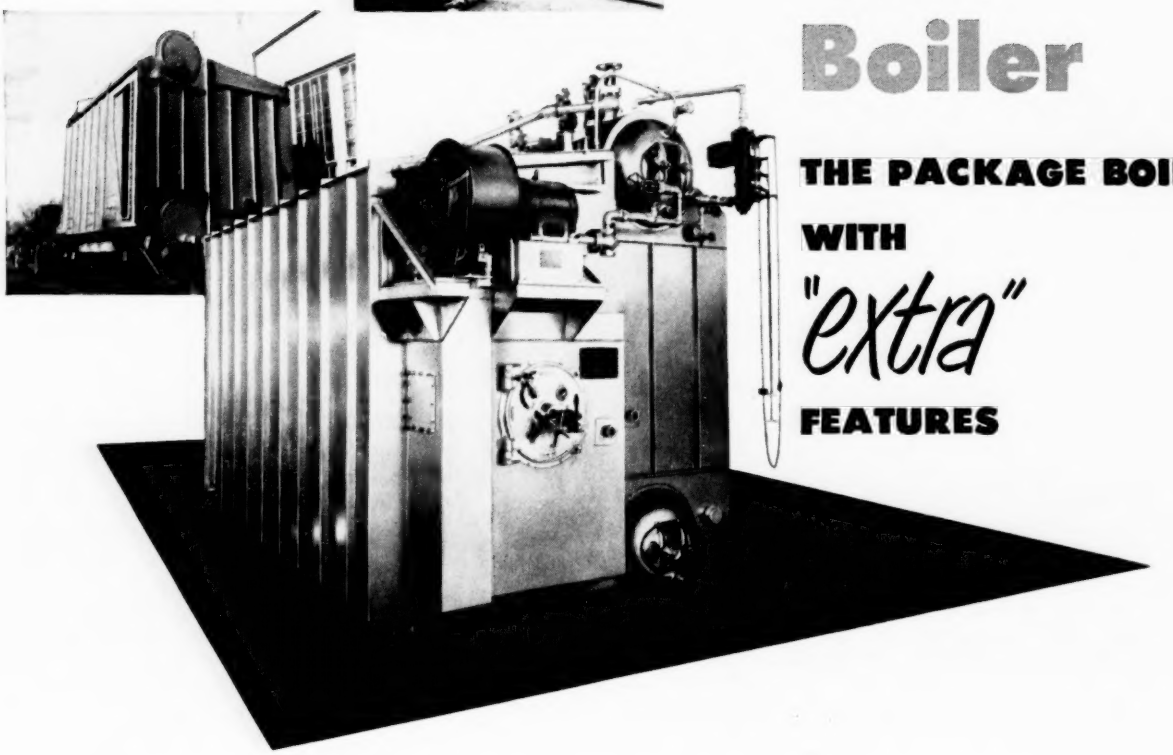
Cleaver-Brooks

Originators of the Self-Contained Steam Boiler

CLEAVER-BROOKS COMPANY
Dept. D-315 E. Keefe Ave., Milwaukee 12, Wis., U.S.A.
Cable Address: Clebro-Milwaukeewis
Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners



the VP Boiler



THE PACKAGE BOILER WITH "extra" FEATURES

Most of the water-tube "package" boilers available today look very much alike. As a matter of fact, in some respects they are alike.

The prospective purchaser's job is to discover which of the several package boilers now available offers a combination of features and advantages that adds up to the "best buy".

Consider, then, the fact that the C-E Package Boiler, Type VP, has *all* the design features offered by any of its contemporaries *plus* the important extra features described at the right.

VP Boilers are available in capacities from 4,000 to 30,000 lb of steam per hr; pressures to 250 psi. Send for Bulletin V-20.

FULLY WATER-COOLED FURNACE — Even the front or "burner" wall is protected, except in three smallest sizes. Has higher ratio of furnace-wall cooling to furnace volume than any boiler of its size and type. Assures rapid and efficient heat absorption, lower gas temperatures entering convection bank, reduced tendency to slag formation. Minimizes furnace maintenance.

LARGER LOWER DRUM — The large lower drum, 30″ in diameter, permits simple, symmetrical tube arrangement; provides easy access when necessary for washing down or for inspection; greater water storage capacity facilitates handling fluctuating loads.

CENTRIFUGAL FAN — This type of fan is more efficient, operates at lower speed and is quiet in operation. The average noise level is less than half that of typical high-speed blowers used on most boilers of this type. Low noise level is particularly advantageous in confined space and in such installations as hospitals.

SIMPLE BAFFLE ARRANGEMENT — Minimum changes in direction (no baffle at all in convection bank in larger size units). Gives lower draft loss. Simplifies soot blowing. Cross-flow of gas with elimination of dead pockets gives maximum heat pick-up. Water-cooled baffle in intermediate sizes insures minimum maintenance.

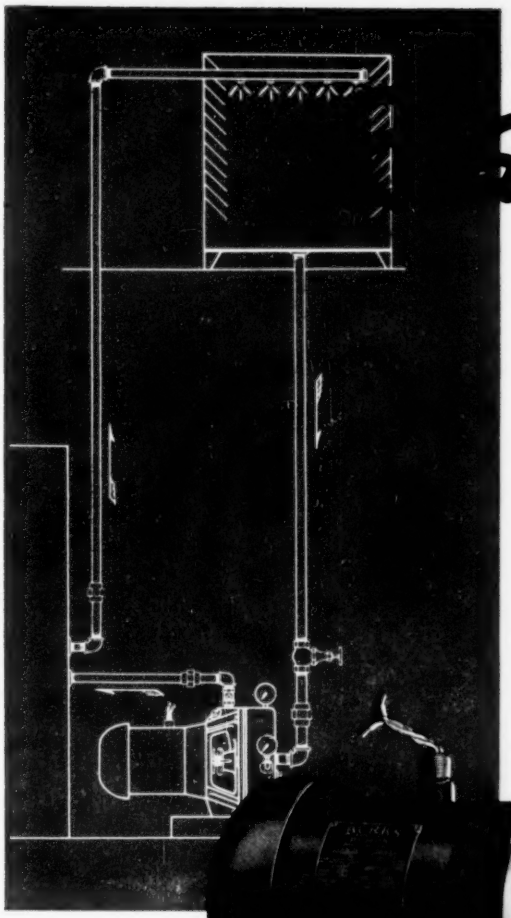
B-652B

COMBUSTION ENGINEERING—SUPERHEATER, INC.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

C·E

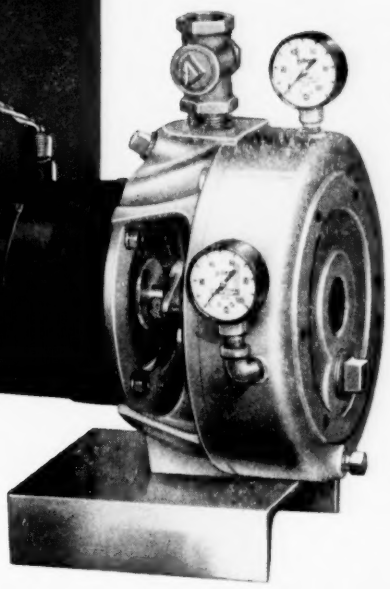
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



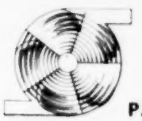
ady...NOW!

THE NEW BURKS IHV SERIES PUMPS FOR AIR CONDITIONING APPLICATIONS

Here they are – the great new Burks IHV Series Centrifugal pumps! Designed especially for air conditioning use – and engineered for highest possible efficiency.



- Can be used either horizontally or vertically—without any mechanical changes.
- Patented "Kam-Action" impeller-volute combinations.
- Full length solid stainless steel shaft. Assures perfect alignment of motor, shaft and impeller.
- Balanced bronze impeller means smooth, quiet operation.
- Available in sizes from ¼ hp. through 5 hp.—single and 3-phase.
- Heads to 195 feet—capacities to 110 gallons per minute.
- Equipped with supply and discharge pressure gauges, and control valve for adjusting to the most efficient pressure for each installation.



PATENTED

"KAM-ACTION"

An exclusive Burks impeller design with straight-line volute. Increases efficiency, performance, and pumping capacity.

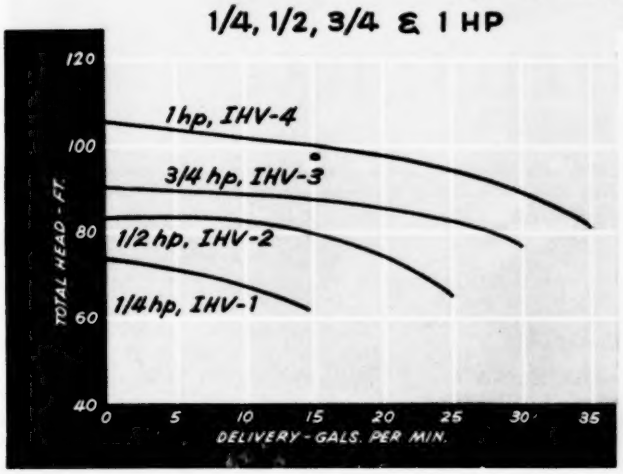
Write—today—for full details

DECATUR
PUMP COMPANY
75 Elk St., Decatur 70, Ill.

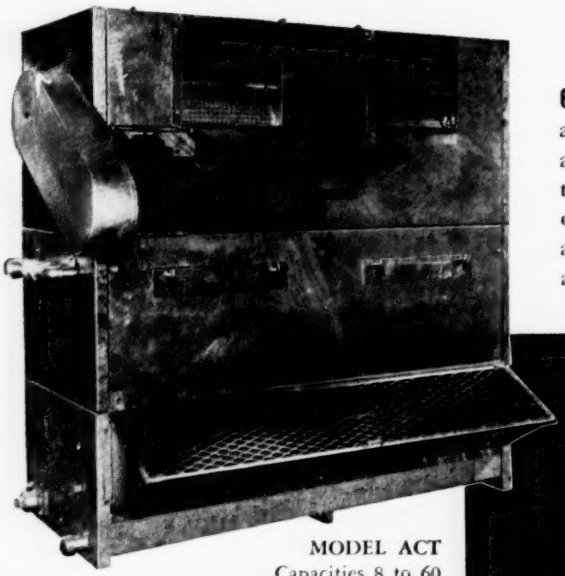
PERFORMANCE CURVES

BURKS IHV SERIES PUMPS

1/4, 1/2, 3/4 & 1 HP



1½, 2, 3, & 5 HP



MODEL ACT
Capacities 8 to 60 tons. 25 ton unit shown.

ease of installation: Acme's compact, pre-assembled, packaged units simplify field erection since they are ready for either indoor or outdoor service when they leave the factory; choice of air discharge direction with either front or rear air intake allows you to fit the job with minor field adjustments. A complete selection of pumps is available. They are integrally mounted and piped at the factory.

Acme

has what you are looking for in

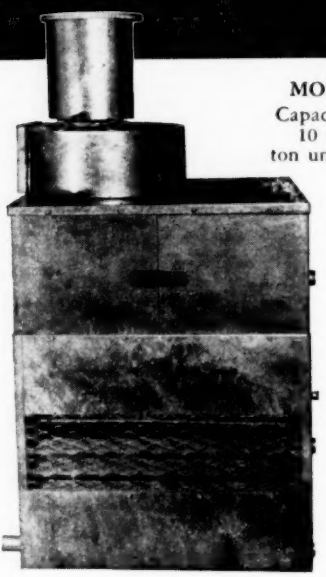
COOLING TOWERS

top performance: Induced draft by means of centrifugal type fan wheels, dynamically balanced for smooth, quiet, efficient operation, assures constant capacity at all times regardless of wind conditions.

Acme's heavy duty all metal eliminators produce maximum changes in direction of air flow while removing entrained water droplets with low static loss. The new heavy gauge steel "Acme-Pak" is designed to provide the maximum in cooling effect.

Both the eliminator and pack are encased in a tight fitting exterior framework resulting in quiet operation and the prevention of air leakage, assuring efficient performance.

durability: Acme's completely galvanized construction of heavy gauge steel and die formed structural panels provides extra strength, extreme rigidity, freedom from vibration and long trouble-free life.



MODEL JCT
Capacities 3 to 10 tons. 7½ ton unit shown.

ACME INDUSTRIES, INC.

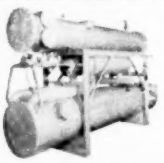
JACKSON, MICHIGAN

M/gs. of a complete line of Air Conditioning and Refrigeration Equipment

Evaporative Condensers
Cooling Towers
Floor-type Unit Coolers

Direct Expansion (Dry-Ex) and Flooded Liquid Chillers
Heat Exchangers, Oil Separators

Shell and Tube, Shell and Coil Condensers
Receivers, Pipe Coils



Packaged Liquid Chillers to 225 tons

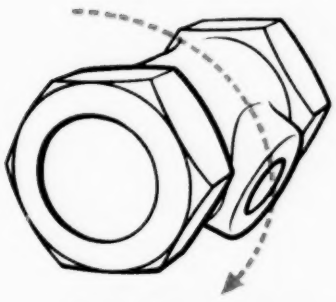
Flow-Temp Heat Pumps
Flow-Cold Liquid Chillers

Remote Room Conditioner

Continuously serving the refrigeration and air conditioning industry since 1919

ONLY ONE MONOFLO FITTING NEEDED FOR MOST INSTALLATIONS

Install a Monoflo Fitting at either the supply or return riser—results are equally effective



Special Down-feed Fittings eliminated

Different Monoflo Fittings for up-feed and down-feed radiators are not required. By *revolving* either a Supply Fitting or Return Fitting so that the riser opening is down, it can be used for down-feed radiators.

B & G Monoflo Fittings enable you to design a forced hot water system with assurance that it will be correctly and efficiently circulated. That's because the Monoflo Fitting is an *engineered* device—not just a "scoop" or "choke."

Under average conditions, *a single Monoflo provides ample diversion capacity!* In abnormally long pipe runs or where unusually large heating loads must be handled, a Monoflo Fitting may be required at both supply and return risers. Down-feed radiation likewise requires two Fittings.

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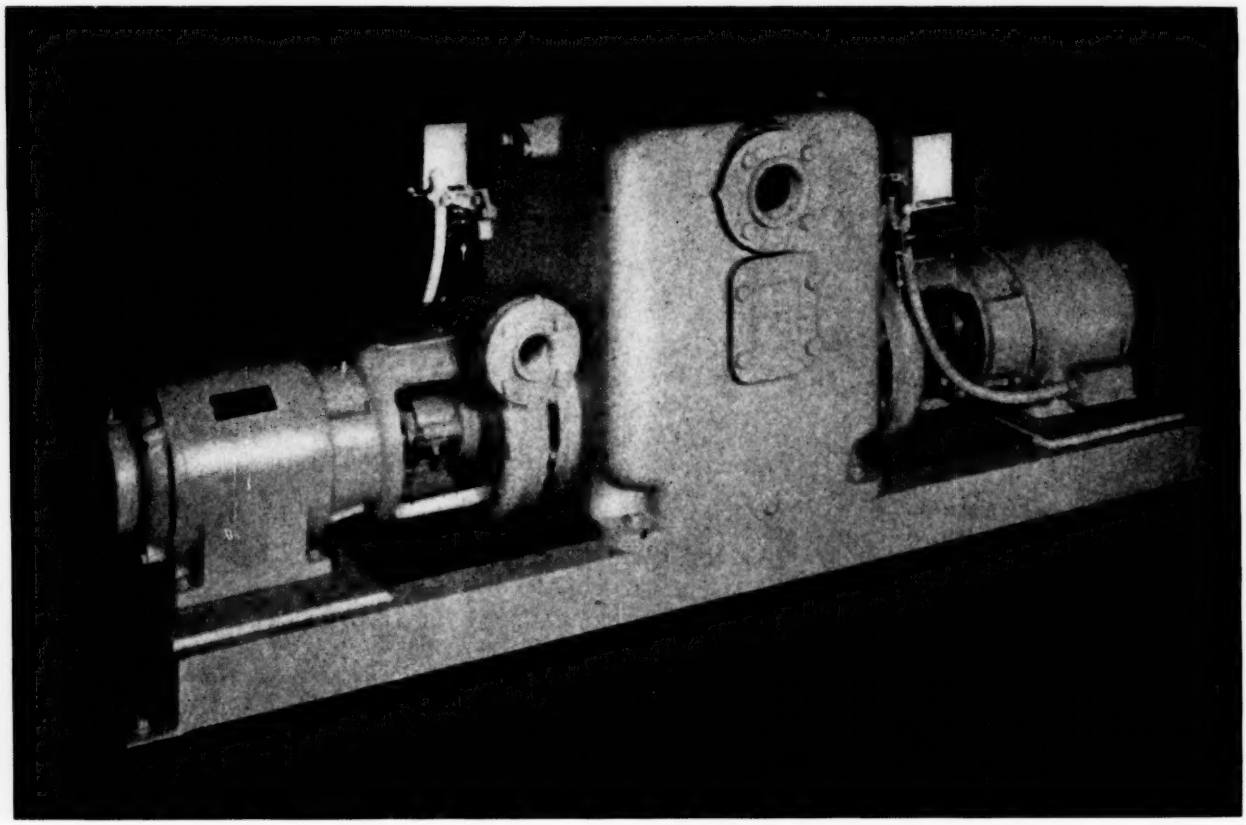

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THE NASH ENGINEERING COMPANY

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Sizing the Expansion Valve in Air Conditioning Systems

F. Y. CARTER

Manager, Refrigeration Division, Detroit Controls Corp., Detroit, Mich.

In laying out air conditioning systems, the thermostatic expansion valve must be properly sized if the entire system is to function in a satisfactory manner.

UNDER the most favorable conditions, a thermostatic expansion valve applied to an air conditioning system must satisfactorily control the flow of refrigerant over a wide range of capacities. This range may vary from 100% at design conditions to as little as 30% at low load conditions. Modern compressors are designed with unloading devices which go into action once the suction pressure has been lowered to a selected value. The compressor may then be unloaded by as much as 70% over a range of 5 psi as the suction pressure continues to fall. Thus while the capacity varies drastically over this range, the evaporating temperature of the refrigerant remains within desirable minimum limits.

In most cases the expansion valve must be flexible enough to adjust itself to any of these conditions and, consequently, must be designed with sufficient regulation to accomplish this within acceptable superheat limits. Thus the initial selection of the expansion valve for operation at design conditions becomes very important since this will insure the best possible operation at the low load conditions.

Variations with Loads

Let us consider the change in operation of an air conditioning system as the load decreases and the capacity control device goes into operation. Since this type of system operates continuously, the evaporator and compressor capacities are always in balance, with the evaporator being completely refrigerated at all times. As the load decreases without any change in the amount of refrigerated evaporator surface, the refrigeration engineer immediately analyzes this as a lowering of the difference between temperature of air entering coil and low side refrigerant saturation temperature (Td) at which the evaporator is operating. A sudden decrease in the compressor capacity results in a new balance point between the compressor and the evaporator at a higher suction pressure but on the same evaporator capacity line of a characteristic curve.

The equivalent *Td* at which the air conditioning evaporator operates, is usually quite high. Since in most cases it is counter flow with reference to return air, and refrigerant is used, there is generally more than sufficient superheat available to operate the valve. However, in some instances parallel flow is used, in which case the feeler bulb is located in the leaving air, and superheat to operate the valve becomes a major problem. For satisfactory thermostatic expansion valve operation, the operating superheat of the valve must always be less than the temperature difference between the air passing over or surrounding the feeler bulb and the saturation temperature of the refrigerant in the coil. Normally it would be said that the coil *Td* must be greater than the operating superheat, but this by our definition of *Td* would not safely cover the case where parallel flow is used in the design.

When the coil and valve are selected in accordance with this rule, it becomes impossible for the feeler bulb to be cooled to the temperature at which it must operate by the air surrounding it. The refrigerant in the coil becomes the predominating factor and will cool the bulb to throttle the flow of refrigerant only after the coil is completely refrigerated.

In laying out the system, the suction pressure is determined by the load requirements and the evaporator is selected accordingly. The expansion valve must then be selected with respect to capacity and superheat to satisfactorily supply the needed refrigerant to the coil.

Thermostatic Expansion Valve

An understanding of the thermostatic expansion valve with respect to design and performance characteristics will materially aid in application of the valves. A brief review of these characteristics is, therefore, in order.

The thermostatic expansion valve is a pressure reducing valve actuated by a difference of pressures. Fig. 1 illustrates the basic parts of this type valve. The valve is equipped with a charged power element of which the

movable diaphragm is an integral part. Thus any pressure exerted by the power element charge acts on the diaphragm and tends to move it downward and push the needle valve off the seat. When the valve is installed in a system, the suction pressure acts on the opposite side of the diaphragm and tends to move it upward and permit the needle valve to return to the seat. The pressure within the power element is determined by the temperature of the feeler bulb and since the temperature of the refrigerant approaching the bulb through the suction line is the only means of reducing this temperature, and thereby throttling the valve, it is necessary that the saturation temperature of the bulb be somewhat higher than the saturation temperature of the system to insure the valve closing. All forces within the valve must be completely balanced at all times when the valve is in operation. Inasmuch as the saturation pressure of the power element is higher than the system pressure, a fixed spring force is provided to bring the forces into balance.

The difference between the bulb temperature and the suction saturation temperature is the bulb superheat and is determined by the force of the fixed spring. Thus a 10 degree superheat setting indicates that the needle will just begin to move away from the seat when the feeler bulb is 10F higher than the suction saturation temperature. If the feeler bulb temperature then increases while the suction pressure remains constant, the bulb superheat is higher than 10 degrees and the needle moves off the seat far enough to compress the fixed spring until a new equilibrium, or balance, is attained. The additional superheat needed to push the valve off the seat in relation to the rated opening is very important since it determines the valve regulation.

Superheat to Open Valve

Fig. 2 illustrates the additional superheat needed to open the valve. The "factory setting" or the superheat needed to just start opening the valve can be anything, for instance, 4, 6, 8, 10 or 15F, but once the needle starts to move, it will always take the same change in pressure difference to open the valve the same amount. The additional superheat required to move the needle from the closed position to the rated position is called the "opening" superheat. During throttling periods, the needle can

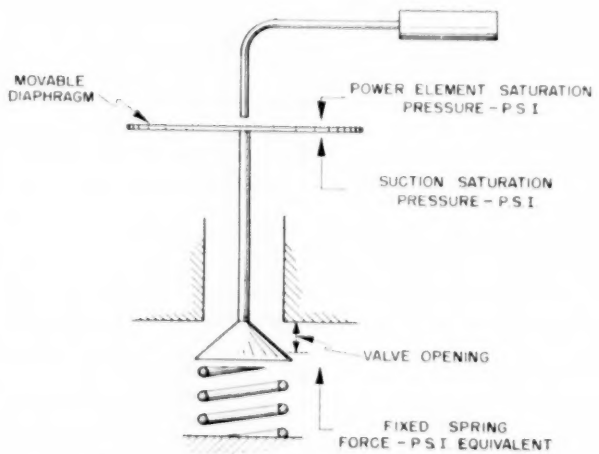

MOVABLE DIAPHRAGM
POWER ELEMENT SATURATION PRESSURE - P S I
SUCTION SATURATION PRESSURE - P S I
VALVE OPENING
FIXED SPRING FORCE - P S I EQUIVALENT

Fig. 1. Basic parts of the thermostatic expansion valve.

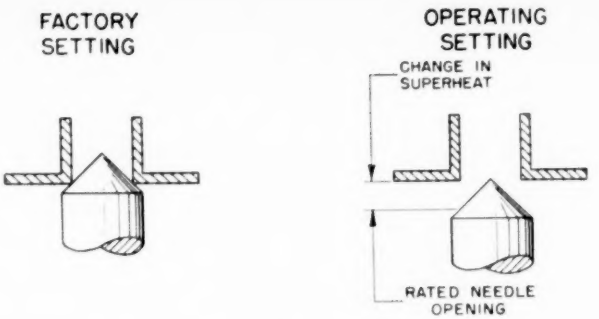


Fig. 2. Difference between factory setting and operating setting for a valve.

be in any position between closed and rated opening and the opening superheat will be directly proportional to this position. As an example, a valve requiring 4 degrees opening superheat will be 50% open with 2 degrees opening superheat.

The "operating" superheat at which the valve works in the application, will be the sum of the "factory" and the "opening" superheats.

The amount of valve opening needed to satisfy the compressor demand will determine the "opening" superheat. For instance, a valve may be rated at 10 tons with a 4 degrees opening superheat. The factory setting may be 10F. This valve when delivering 10 tons capacity will operate at 10 + 4 or 14 degrees superheat. When the load falls off, this same valve may be called on to furnish only 2½ tons capacity, in which case it would adjust itself to a smaller opening requiring only 1 degree opening superheat. The valve would then operate at 10 + 1 or 11 degrees superheat.

The change in superheat resulting from the change in demand thus becomes very important. Will the evaporator be completely refrigerated with 14 degrees SH (superheat) at full demand and only 11 degrees SH at 25% demand? Fortunately, the operation under these two conditions is satisfactory and a valve is said to have good regulation with opening superheats in the range of 3 to 6F.

It should be apparent from this explanation that superheat really controls only the flow area of the valve orifice. The valve capacity depends on many factors, such as orifice flow area, suction pressure, pressure difference across orifice, quality of inlet liquid, temperature of inlet liquid, and in the case of a pressure distributor, the pressure at the downstream side of the valve orifice. When any of these factors vary enough to upset the valve capacity, the feeler bulb reacts accordingly and the valve attempts to readjust the flow area to meet the new demand. This is not always possible as will be shown later.

Since so many factors affect the valve capacity, it is necessary to rate the expansion valve at selected standard conditions which for air conditioning applications are 100F saturated gas free inlet liquid and 40F, saturated outlet with an opening superheat designated by the valve manufacturer.

Conditions Affecting Expansion Valve Performance

The expansion valve is the heart of the refrigeration system and many conditions found in the application will

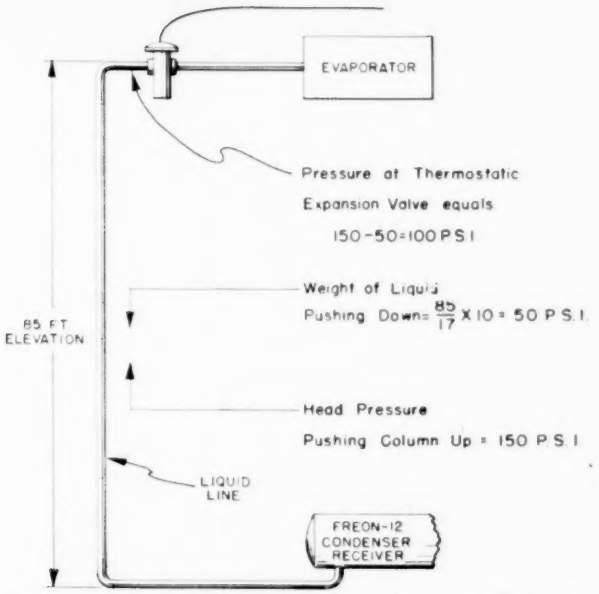


Fig. 3. Elevation of liquid line is a common cause of air conditioning trouble.

adversely affect its performance. Corrections in some cases and allowances in others are necessary, and each of these conditions will be discussed hereafter. It is assumed that proper sized liquid and suction lines have been selected.

Elevation of liquid lines, illustrated in Fig. 3, is a very common cause of trouble in air conditioning systems. Liquid refrigerant is heavy. For example, Freon-12 has a density of 78.8 lb per cu ft at 100F. When the evaporator and expansion valve are located above the compressor and receiver, the weight of the column of liquid Freon-12 exerts a downward force which is equivalent to a pressure of 10 psi for each 17 ft of elevation. The receiver pressure exerts a force to push this column of liquid Freon-12 up to the expansion valve. The loss of pressure to overcome the weight of the liquid column results in a much lower pressure at the expansion valve. Fig. 3 shows the pressure pushing up is 150 psi and that the pressure pushing down, due to the weight of the refrigerant is 50 psi so that the pressure at the expansion valve becomes 150 — 50 or 100 psi. The liquid leaving the receiver is usually near saturation temperature and has enough internal heat to cause boiling in the liquid line at the lower pressure existing at the expansion valve. Gassing results which means the valve must pass a greater volume of refrigerant and at a much lower differential across the valve. Obviously unless elevation is considered, and corrective measures taken, unsatisfactory valve performance will result.

De-elevation in liquid lines is just the reverse. The weight of the column adds to the receiver pressure to cause a much greater inlet pressure to the expansion valve. This results in a higher differential across the valve which may cause erratic feeding and in some cases chatter due to the liquid hammer effect of the column. In this case a smaller valve usually helps.

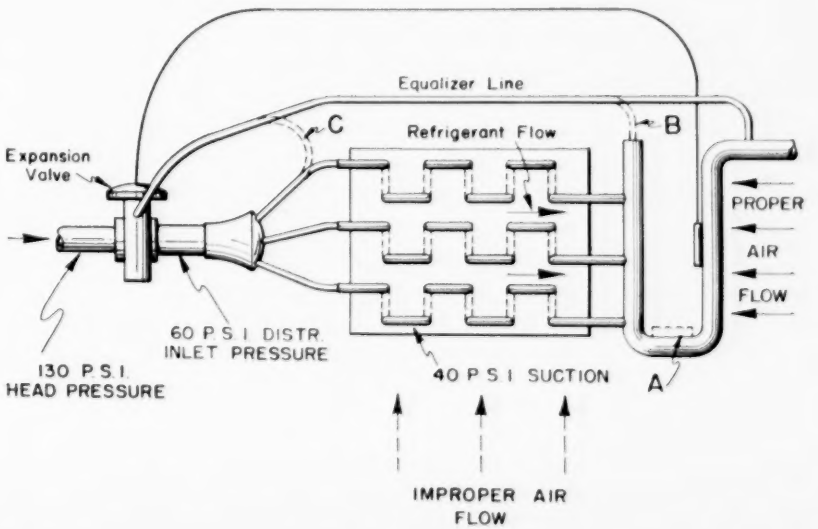
Air flow and coil circuiting are very important. Air conditioning coils are usually of the multi-pass type fed with a distributor. The distributor is nearly always designed to feed an equal amount of refrigerant to each section of the coil. Therefore, the air must be forced over the coil evenly so that each refrigerant circuit receives equal loading. If such is not the case, the circuit with the lowest load will let refrigerant reach the feeler bulb and throttle the flow to satisfy that particular circuit. Obviously the remaining sections of the coil will be starved. Fig. 4 illustrates the correct method of air flow.

Having the air counter flow to the refrigerant flow assures that the feeler bulb will have sufficient superheat for valve operation.

Trapping the feeler bulb as at *A* in Fig. 4 should be avoided. Any spill-over of lowside liquid will lay in this trap and cool the feeler bulb to saturation temperature which causes the valve to close. It will not open again usually until the spill-over has been completely evaporated. This action results in bad "hunting" of the expansion valve.

Location of the external equalizer connection is quite important. Refer to Fig. 4. The ideal location is in the suction line downstream from the feeler bulb of the valve. This location completely eliminates the effect of pressure drop in the distributor and the coil on valve operation. At the same time any small equalizer leakage will not affect the feeler bulb. Sometimes it is more con-

Fig. 4 Correct method of air flow and the proper location of the feeler bulb for satisfactory valve operation.



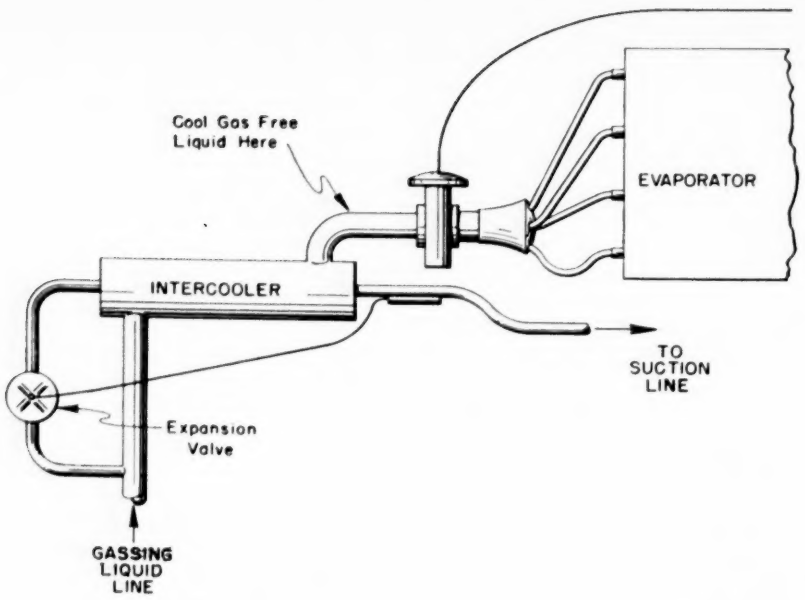


Fig. 5. Simple method of sub-cooling by running the gassing liquid through a heat exchanger.

venient to locate the equalizer connection in the coil header as at *B* and this is usually satisfactory inasmuch as very few valves develop equalizer leaks. The equalizer line is also sometimes connected to the coil inlet by teeing into a distributor feed tube as at *C*.

This is satisfactory where the coil has no pressure drop. If the coil does have pressure drop, this method will not prove satisfactory.

One important fact to remember is to bring the equalizer connection off at the top of the suction line or header. This will prevent oil logging of the equalizer line, something which occasionally occurs when the equalizer line comes off the bottom of a header.

A pressure distributor requires a large pressure drop for proper operation. Note in Fig. 4 that while the coil is operating at 40 psi, the pressure between the valve outlet and distributor inlet is 60 psi. This lowers the pressure difference across the valve which now must assume a wider open position to supply the same capacity. Some makes of valves are provided with extra needle opening. These valves will adjust themselves to the wider open position with an additional degree or so of opening superheat. Other makes are not as flexible and a larger valve is required when a pressure distributor is used. Data on this feature can always be obtained from the manufacturer's catalog or representative.

The engineer must take all these factors into account in order to properly select the expansion valve for the air conditioning application and to insure its satisfactory operation.

To summarize, he must take steps to eliminate gas formation in elevated liquid lines. The elevation is sometimes necessary, but all that is needed to prevent gassing is to sub-cool the liquid to a temperature below the saturation temperature existing at the expansion valve. Fig. 5 illustrates one rather simple method of sub-cooling. Simply run the gassing liquid through a heat exchanger which is used as an intercooler by applying a small thermostatic expansion valve as shown. In addition:

He must compensate for any loss of head pressure resulting in a lower pressure differential across the valve.

He must be sure load variation is within range of valve operation.

He must be sure feeler bulb and equalizer line are applied so that valve can perform satisfactorily.

He must be sure the coil design is proper for his application.

If these factors are considered properly, the correct valve can be selected from the manufacturer's catalogs. It is vitally necessary, however, that this selection be made on conditions existing right at the expansion valve.

Accident Rate for Contractors is Low

According to a study made by the U. S. Department of Labor, employees of heating, plumbing and air conditioning specialty contractors experienced an average of 28.5 disabling injuries for every million employee-hours worked during 1950. For 1949 the average is 30.7 and for 1948, it is 30.6.

In comparison with the injury rates for other types of construction work, the injury frequency rate for this group in 1950 was relatively low. The all-construction rate, for example was 41.0; the rate for general contracting operations, 44.5; and the average rate for all types of special trades contracting was the frequency of 33.4.

Comparison of the 28.5 injury frequency rate for heating, plumbing and air conditioning was almost double the 14.7 rate for all manufacturing in 1950. The accidental death rate was also three times that of all manufacturing, but workers in manufacturing plants have a much higher ratio of permanent impairments.

Results of this study are given in detail in Bulletin No. 1079 on Injuries and Accident Causes in Plumbing Operations. It covers accidents for the years 1948 and 1949.

Air Conditioning the Automobile

MELVIN KALFUS

Assistant Editor, Heating and Ventilating

Current designs of air conditioning systems for installation in 1953 automobiles are described. Problems which were met and overcome are covered, and needs shown for future investigation. Design features and operation of systems used by three manufacturers are presented.

ALTHOUGH the first investigations of the application of air conditioning to the automotive industry led to installation of a few units in automobiles during the middle 1930s, factory installed car cooling systems are being used for the first time in several 1953 automobile lines. Previous systems were mainly of the package recirculating type purchased from a manufacturer other than the producer of the car. This year, however, air conditioning systems are being installed as an integral part of the automobile.

Inherent in the concept of placing an entire air conditioning system within the framework of the car, are many basic problems in space requirements, power, distribution, and control. In discussing these problems and their solutions to date, a comparison will be made between three systems used in 1953 models: General Motors' Frigidaire system employed with variations by Oldsmobile, Buick, and Cadillac; the Chrysler Airtemp unit used by Chrysler and DeSoto; and a system designed by Ford Laboratories used by Lincoln and Mercury.

Mechanical refrigeration is used by all automobile manufacturers. Once this design was generally accepted as the basic system to be used, there followed the problem of where to put the system components. A package type unit placed in the trunk of the car was shown to be too bulky and too costly. Separate drive units, openings for intake and discharge in and around the trunk, and circulation requirements were all considered prohibitive.

Thus, the components of each of the major systems must be distributed around the car body, at points where they will do the most efficient job and where space is available. This has the advantage of using common and available parts. The main disadvantage of the overall system is that the scattering of the parts makes servicing difficult, and the many connections are possibilities for leaks and failures.

Compressor

To obviate the need for a separate drive unit, the compressor must be placed near a source of power. In all cases, the compressor was mounted upon the automobile's engine, and operated by a belt drive. The Chrysler Airtemp compressor is a 4-cylinder V-type unit weighing over 60 pounds and driven by a double V-belt from the crankshaft pulley. Frigidaire's compressor is a 2-vane rotary type weighing 51.5 pounds and driven by two V-belts at a 1.1 to 1 engine speed.

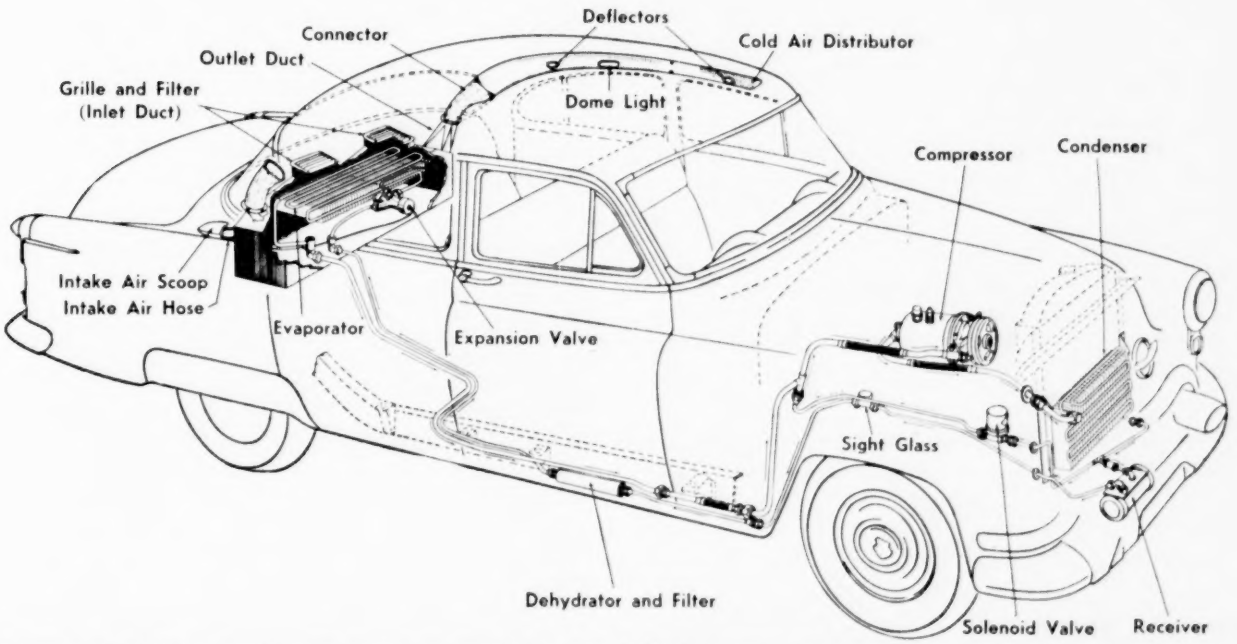
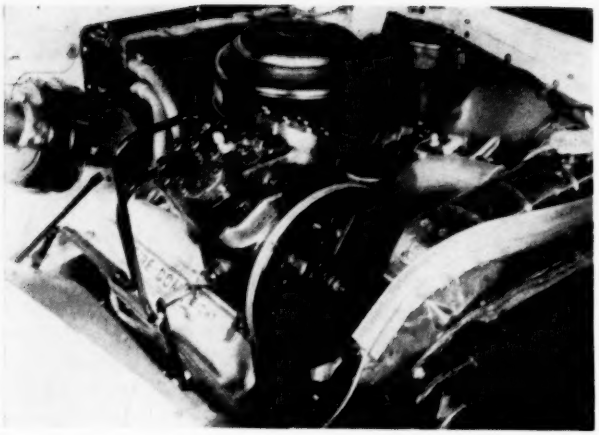


Diagram of Frigidaire conditioning system as installed in the 1953 Oldsmobile. The same system is installed with minor variations in the Cadillac and Buick lines, and the system is representative of typical automotive mechanical refrigeration.



Engine-driven compressor is mounted on right side of engine in Chrysler Airtemp's conditioning system.

There are several problems in the placement and use of the compressor still to be solved. Placing the compressor under the hood gives a satisfactory source of power, but the weight of the compressor has an unfavorable effect on performance and engine balance. Due to compressor size, the unit overcrowds the already congested space under the hood.

Condenser

In the placement of the air-cooled condenser, the major consideration was sufficient air flow around the unit. The solution employed by all three systems was to place the condenser in front of, and somewhat below the level of the engine radiator. This employs the incoming air stream as the cooling medium, yet allows space for part of the air stream to reach the radiator.

While there is certainly enough room for the condenser in this location, other problems arose. The condenser competes with the radiator for the air stream, and when the car is travelling at low speed or idling, thus cutting down on the ram air, the radiator fan cannot supply enough air for both radiator and condenser. Air passing from the condenser to the radiator will be preheated, too. Also, it is not possible in all car designs to leave much room between the levels of the top of the radiator and the top of the condenser.

Receiver

The receiver is small and permits considerable installation latitude. Frigidaire places it under the condenser, Ford has it under a fender, and Chrysler puts it under the car at the trunk.

Cooling Unit

In all systems, the cooling or evaporator unit is mounted in the trunk of the car, just below the package shelf. The unit consists of the evaporator coils, expansion valve, blowers, and, in the case of Chrysler, dehydrator and filter as well. Ford places the dehydrator and filter away from the unit, under a rear fender, and Frigidaire places them beneath the car near the front seat. This location is satisfactory for space and distribution, although the unit is bulky and cuts down trunk space. Braces support the unit, and deaden vibration.

Distribution

In the Chrysler Airtemp system, partial fresh air is introduced through inlet grilles above the rear fender, and constitutes approximately 25% (about 125 cfm) of the air discharged in the car's interior. Return air enters through return grilles mounted in both ends of the package shelf. The mixture of fresh and recirculated air is blown over the cooling coils and out to the car's interior through a discharge grille in the center of the package shelf, upward along the roof of the car over its entire length. The two centrifugal blowers used in the system are powered by the car's electrical system.

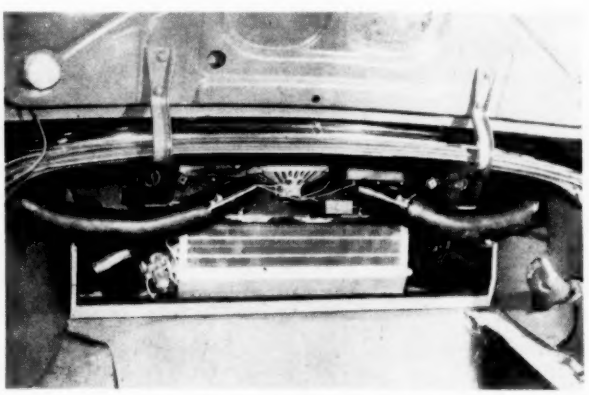
Frigidaire's system is the same in both the Buick and Oldsmobile lines. Intake grilles for fresh air are mounted on the body above the rear fenders. At 50 mph, the intakes allow 60 cfm of outside air to enter and to travel to the evaporator unit through transparent plastic ducts. Two grilles for picking up return air are mounted in the package shelf. The returned air, together with the fresh air, is blown over the cooling coils and distributed through a duct along the side above the door. Air is discharged through about 1,500 small holes in the duct and through two manually operated outlets of the type used in commercial airliners. Two electric blowers, operating on the car's electrical system, are used. Cadillac uses the same system, except that it has two outlet air ducts at the side of the package shelf, and an inlet grille in the center of the shelf. No overhead system is used.

Ford has a recirculating type system. Electric driven blowers circulate cooled air through grilles in the package shelf. Air returns in grilles underneath the front and rear seats.

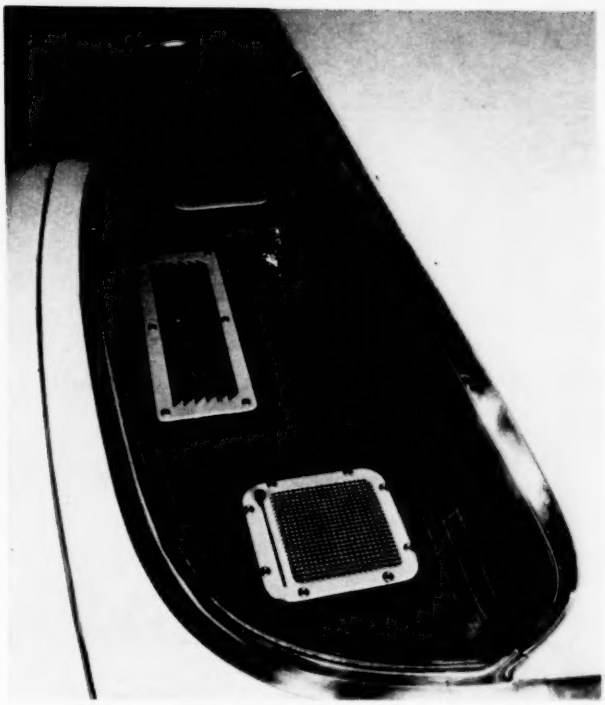
In all three cases, problems that arise are (1) the electrical motor driven blowers impose an extra load on an electrical system that probably is already overloaded, and (2) the air distribution system cannot be considered good, because even-air-distribution is still not assured.

Refrigeration Control

The most obvious problems, which have not been mentioned yet, are those encountered in trying to maintain a satisfactory comfort condition in the automobile



Evaporator unit of Frigidaire conditioning system as installed under the shelf, in the trunk of the Oldsmobile.



Center cooled air outlet and two end warm air returns distribute air in the Airtemp system in the 1953 De Soto.

at all times and under all conditions. Consider the obstacles faced. The compressor must have sufficient capacity when travelling at low or city speeds or at idle, and yet must not have too much capacity at high speeds.

The air conditioning system is a summer-time luxury, and during the summer months the automobile is subjected to a large radiant heat load from the sun and a considerable heat load from the engine, when the small air volume in the car to be cooled is considered. In addition there is the heat gain from a heavy passenger load of, say, six persons. There is the danger of cooling the head and shoulders of passengers with little cooling effect below that zone.

Obviously, if the amount of cooling accomplished were to always be the maximum, the occupants would be frozen half the time. On the other hand, if the engine speed driving the compressor were to be the only control, the system would be useless at the times of low speeds through city traffic or traffic snarls.

If a car has to stand for any length of time in hot weather, the air conditioning must work quickly after the engine is started.

Control Systems

Oldsmobile devised a system employing a thermostat to solve the control problem. A capillary tube in the return air stream actuates a pre-set thermostat which, in turn, controls the normally open by-pass valve located between the condenser and compressor intake. When cooling is required, the valve closes, and when the car cools, the valve opens which reduces compressor discharge. The thermostat has a 10F range and controls inside temperature to within 3F of the setting. The previously mentioned airliner diffusers can moderate air discharge for different needs. A switch control on the panel has an off-control; a cold control which puts the thermostat into use and turns on the blower; a cool control that turns on the blower but keeps the by-pass valve in the open position.

The Cadillac control panel has controls for modulating each of the two blower speeds, and a sliding knob for adjusting cooling capacity.

Chrysler Airtemp has considered several solutions to the control problem. One method would be to have the compressor and engine directly coupled, but to have a means of controlling the volume of air passing through the evaporator. A throttling valve, with a panel control knob, would be placed in the compressor intake.

Another solution considered a switch for varying the evaporator air flow and a variable speed clutch for controlling compressor speed to meet capacity requirements. A thermostat could be employed with either system.

The use of a by-pass line with an automatic solenoid or modulating valve, designed to by-pass a portion of the compressor discharge from entering condenser, was also considered. As the cooling needs decreased, more hot high pressure gas enters the evaporator coil and mixes with the cold low pressure gas from the expansion valve, increasing pressure and temperature in the evaporator, thereby decreasing the unit's capacity.

Design Data

Chrysler Airtemp figured good design conditions to be 75F DB and 65F WB inside the car when outside conditions were 95F DB and 80F WB. A good unit, under this design, is capable of reducing car temperature from 130F (after parking in the sun) to 85F within two minutes. Air velocities of 1,400 to 1,600 fpm from the discharge grille is permitted. Approximately 1¼ to 1½ tons of refrigeration could be supplied with this design. Systems now installed in Chrysler and DeSoto cars are said to be able to cool a car interior from 115F to the seventies in the time the car travels four blocks, and the indoor temperature is maintained in the seventies even when the outdoor temperature is over 100F.

Oldsmobile's system will hold the inside temperature at 72F if the outdoor temperature is up to 104F. The duct discharge air temperature is 49F and the return air temperature may be 67F. Even though outside temperatures may be from 80 to 100F and the relative humidity from 20 to 85%, the RH inside the car always is in the range of 45 to 55% with temperatures from 69 to 71F.

Buick's unit has a capacity of 300 cfm of air, and it provides a complete air change every 20 seconds. When the car is moving at 45 mph, the refrigerating effect is said to equal that of 32 average size refrigerators.

The system in the 1953 Lincoln will create a 72F temperature at breathing level if the ambient air temperature is 90F, and 78F if the ambient air is 110F.

Expanding Application

Packard has announced that its 1953 model can be obtained with air conditioning operated by a regular switch on the instrument panel. This system, too, uses two blowers and will maintain a low of 64F in the interior during the most severe summer conditions.

Research has also been started on air conditioning applications in automobiles by Nash, Studebaker, and Hudson, who have announced that they are seriously considering the inclusion of air conditioning at a future date.

Design of Hay Drying Systems

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Part 2. Equipment Required

Following last month's discussion of design considerations, this conclusion of a two-part article describes required equipment and offers examples of system design.

ALTHOUGH equipment requirements may vary somewhat throughout the country the components discussed in the following paragraphs usually will be considered by the designer in planning an installation.

When using forced natural air in a custom installation the following equipment is generally required:

(a) A fan which has the capacity to supply the needed quantity of air at the desired static pressure. Manufacturers' catalogs are used in making the selection. A flat horsepower curve is desirable, especially when electric motor drive is used, since system pressures vary considerably throughout the drying season. For the same reason a fan having good efficiency over a wide range of operating pressures is desirable. Cost of the fan is naturally an important consideration and so is safety. Fans should be installed with suitable protective screens as a safety measure.

(b) The motor for driving the fan may be either electric or internal combustion engine. The electric motor offers somewhat more flexibility from the standpoint of control and facilitates the use of direct drive when desired. Maximum sizes of electric motors must fall within the limits established by the local electric service organization.

(c) In some installations the motor is directly connected to the fan shaft. In others V-belt drive is customarily used. If the fan manufacturer has not specified the belt and sheave sizes, refer to the belt manufacturers' data books in making the selection.

(d) The controls generally recommended when electric motors are used consist of a magnetic starter with built in overload and low voltage protection for the motor and a time switch (See Fig. 12). The starter protects the motor from overloads and low voltage and facilitates automatic operation in conjunction with the time switch. The motor may be operated continuously with a 15 to 30% overload when it is located in the fan house so as to be in the main air stream.

A general purpose electric clock movement time switch of the single pole, single throw type with 24 hour dial is generally suitable. It is used to automatically start and stop the motor according to a predetermined operating schedule. Although a 115 volt clock motor may be used, one rated at 230 volts can be energized directly from the 230 volt line serving the motor. Switches having three pairs of on-off trippers are generally considered satisfactory.

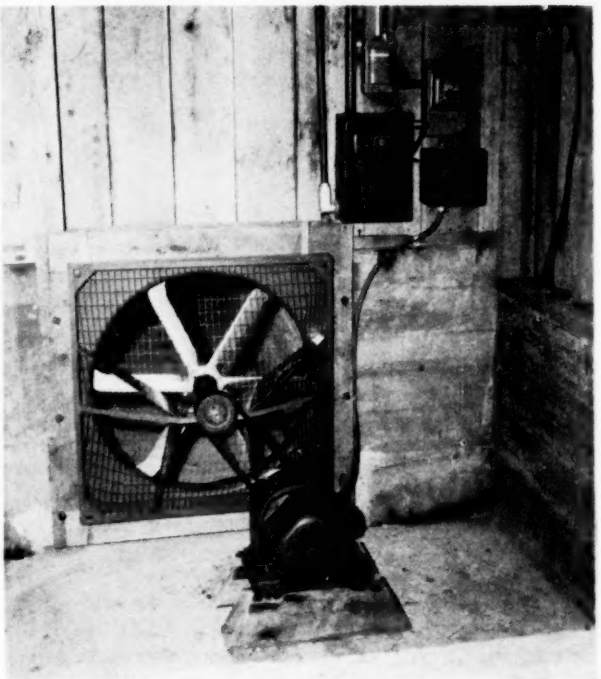


Fig. 12. Fan, motor, and controls installed in fan housing.

When a regular magnetic starter is used, a single pole double throw manual switch should be used also. In one position of the switch, the holding coil is constantly energized. Therefore, should a power interruption occur the motor will start when service is restored. With the switch in the other position, the motor operation is controlled by the time clock. Commercial hay drier controls are available with a built-in switch which provides for either manual operation or automatic operation through the time clock.

(e) In an installation where the fan is placed in the mow, a fan housing becomes a necessity so as to prevent recirculation of air within the mow area. Either an opening to the outside of the barn or one in the fan house floor is used as the air intake. At least one square foot of intake area should be provided for each 1,000 cfm delivered by the fan. Regardless of the fan location provision should be made for relatively unobstructed passage of intake air to it.

(f) Safety equipment—Protective screens should be provided in all installations where there is an element of hazard from moving machinery.

Although the equipment in some heated air installations is custom assembled the majority of those using

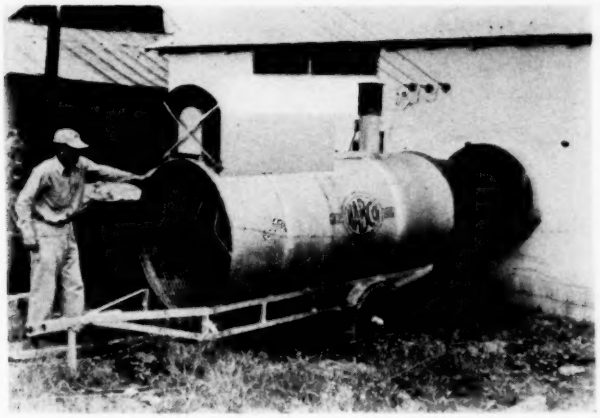


Fig. 13. Portable crop drier including heater.

heated air make use of one of the so-called crop driers. These are commercial units consisting of a fan, motor, controls, heating unit, and heat exchanger assembled as a packaged unit. After designing the air distribution system and selecting the proper crop drier for the job, provision must be made for connecting the drier to the distribution system. A typical drier of this type is pictured in Fig. 13. These units may be used for drying long, chopped, or baled hay and also for drying other farm products such as small grain and shelled and ear corn.

Structural Requirements:—Hay storage structures should be carefully analyzed as a matter of safety. This is especially true when contemplating the installation of a hay drier in existing structures. The original design may not have provided sufficient strength to withstand the heavy loads of relatively green hay. Similarly, in new construction the engineer should satisfy himself that the design provides adequate strength for the anticipated hay loads.

Designed Examples

The many variations in hay drying systems now in use make it impractical to include an illustrative design for each type. However, several typical design problems are illustrated and these should serve as a guide to the designer for working with other systems. In any event the designer should be governed by the conditions prevailing in his state or locality. It is suggested that the state agricultural college be consulted regarding local and state design requirements.

Baled Hay, Example 1

For most effective drying loosely tied bales are recommended. Many balers can be adjusted for different lengths of bales. For convenient handling and stacking on the drier a bale length of 30 to 36 inches is desirable. See Tables 1 and 2 for volume and density of baled hay.

The recommended amount of 35% moisture content hay that should be placed on the drier should not exceed 6 layers with an air flow of 20 to 25 cfm per sq ft of floor area. It is possible that more layers with a lower moisture content may be dried at one time. It is not recommended that the second curing be dried on top of the first curing, i.e., the hay should be removed from the drier after each batch is dried.

The slatted floor system, the center main duct with no auxiliary air distribution system, and the plenum chamber drier are among the systems which have been used satisfactorily for drying baled hay. An example illustrating the design of a slatted floor system for baled hay is presented, in the following paragraphs. The same procedure for selecting a fan may be used for center main duct and plenum chamber systems if proper static pressures are considered.

Selecting the Fans:—Assume that 20 acres of hay will yield 1.5 tons per acre for the first cutting and that one ton occupies 300 cu ft of space (Table 2). Then $20 \times 1.5 \times 300 = 9{,}000$ cu ft. One bale 14 by 18 by 36 inches on edge will cover about 4 sq ft of area. Six bales stacked on edge, that is, on the narrow or cut side, one on top of the other, will occupy about 6.05 cu ft per bale or 40 cu ft. Dividing 9,000 cu ft, the total volume of hay, by 40 and then multiplying by 4 gives 900 sq ft of floor space for 30 tons of 20% moisture hay 6 bales deep, stacked on edge with the cut side of the bale toward the air flow.

After the area of the drying floor has been determined, the fan unit can be selected. The fan for a natural air system should be capable of delivering a minimum of about 20 cfm per sq ft of drying floor area at $\frac{3}{4}$ inch w.g. static pressure. Therefore, the total air required is $900 \times 20 = 18{,}000$ cfm. The fan and motor can be selected by entering manufacturers' tables with these static pressure and air requirements. A portable crop drier using supplemental heat should deliver a minimum of 20 to 25 cfm per sq ft of drying area at $\frac{3}{4}$ inch static pressure. Another guide in design is to be sure the supply of air is of sufficient volume to provide about 600 cfm of air per ton of hay at 20% moisture. Using this rule of thumb the amount of air required in this example is $30 \times 600 = 18{,}000$ cfm.

Size of Main Duct:—Main air ducts built at constant height and width should be large enough to provide a maximum air velocity of 1,000 fpm. For example, if the fan delivers 18,000 cfm the main air duct should have a cross sectional area of at least 18 sq ft. For most propeller type fans installed on systems with main air ducts tapered in height, the fan frame determines the size of the main air duct at the fan. If 2 by 4 inch lumber is used for building the fan frame, the main air duct will usually be large enough to keep the air velocity under 1,600 fpm, which is the maximum velocity normally recommended for tapered ducts.

Air Openings at Bottom of Main Duct:—In determining the width of the air opening at the bottom of the main air duct for center main air ducts with slatted floor on each side, use the formula

$$W = \frac{Q \times 0.006}{L}$$

For a side main duct, the amount is doubled. In either case, W is the width of the crack in inches; Q is cfm of air the fan is rated to deliver, and L is length of air opening along one side of main duct in feet.

Drying Floor:—For systems built of lumber the drying floor should be constructed in sections for easy removal for cleaning under them. The joists for the slatted floor must be at least as wide as the height of the air opening. As an example, if the air opening figures to be 7 inches

high, then it is recommended that 1 by 8 inch rough lumber be used for the joists in the slatted floor. Whether the walls of the drier are solid or not, it is recommended that the air be blocked a distance of 2 ft from the side of the main duct and from all of the side walls. This can be done by placing a solid floor around the outer edge of the drying area. The slatted floor can be made in sections of a convenient size for easy handling.

Air Intake to Fan:—The velocity of the air through the fan intake opening should not exceed 1,000 fpm. If the opening is made smaller, air delivery will be reduced and the fan will operate at lower efficiency. The fan unit and the air intake opening must be located to prevent recirculation of air that has passed through the hay.

Ventilation Above Drying Area:—The drying area must be well ventilated. Unless good ventilation is provided, moisture will condense on the outer surfaces of the bales. There should be at least 1 sq ft of mow ventilation area for each 200 cfm of air delivered by the fan.

Loose Hay, Example 2

A mow, 34 by 48 ft, is to be used for drying alfalfa hay from a 25 acre field. Estimate the yield at 1½ tons per acre for the first cutting and an average of 0.8 tons per acre for two additional cuttings. Single phase motors up to 7½ hp may be used. The fan is to be located in the hay mow with center main and slatted floor distribution system. Additional design data: (a) loose hay occupies about 310 cu ft per ton (from Table 1); (b) not more than 8 ft should be placed on this type drier for the first loading; (c) other loadings not exceeding a maximum depth of 6 ft per loading may be placed on top of the first batch for curing; (d) dry from an initial moisture content of 35% to 20%.

Solution

Tons of hay, first cutting: $1\frac{1}{2} \times 25 = 37.5$ tons.
Storage Volume: $37.5 \times 310 = 11{,}600$ cu ft.
Mow Area: $34 \times 48 = 1{,}632$ sq ft.
Depth of hay in mow (from first cutting)

$$\frac{11{,}600}{1632} = 7.1 \text{ ft.}$$

Amount to be harvested at each of the two remaining cuttings: $25 \times .8 = 20.0$ tons.
Space required for storage: $20 \times 310 = 6{,}200$ cu ft.

$$\text{Depth of storage} = \frac{6200}{1632} = 3.8 \text{ ft for each cutting after the first.}$$

Total depth of storage for 3 cuttings:
$7.1 + 3.8 + 3.8 = 14.7$ ft.
Volume of air needed based on 15 cfm per sq ft at ¾ inch static pressure $= 15 \times 1632 = 24{,}480$ cfm.

Hay 14.7 ft deep is close to the depth requiring 1 inch of static pressure for 15 cfm per sq ft of mow floor area, however, field experience has shown that as the first two loadings of 7.1 + 3.8 ft dry, the static pressure will decrease somewhat. In this example ¾ inch static pressure is satisfactory, since the last depth of 3.8 ft is not loaded on the drier until after the first two depths are dry enough for safe storage.

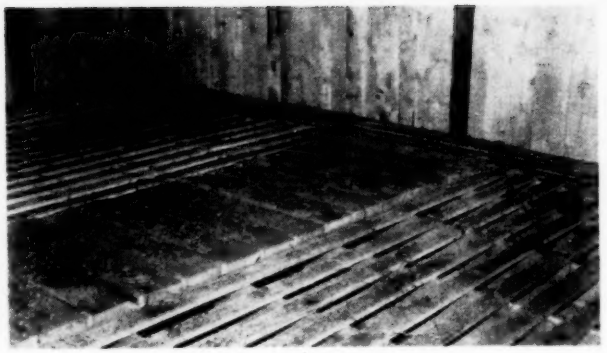


Fig. 14. Slatted floor with center duct flush.

Using manufacturers' catalogs, select a fan which will deliver approximately this volume of air against ¾ inch static pressure. To carry the illustration further, it is found that one manufacturer produces a 42-inch fan rated at 7½ hp which has a rated air delivery under the specified conditions of 27,400 cfm. This volume of air would provide 27,400/1632 or 16.8 cfm per sq ft of mow area which is well within the required limits.

Next determine the size of the air opening at the sides of the main duct. To do this use the formula $W = (Q \times 0.006)\ L$ where W is the width of the crack in inches, Q is the total volume of air in cfm, and L is the length of the air opening along one side of main duct in feet. The main duct should extend no closer than 5 ft from the end of the barn and the inlet end of the fan house will take up about 6 ft. Therefore, L for this 48-ft mow is $48 - (6 + 5) = 37$ ft. Now substituting in the equation $W = (27{,}400 \times 0.006)/37 = 4.44$ inches, which, working to the nearest ⅛ inch, would be 4½ inches.

Determining the Size of the Main Duct:—The 42-inch propeller type fan is mounted in a square frame usually made from either 2 by 4 or 2 by 6 inch rough lumber. If 2 by 4 material is used, the outside dimension of the frame would be approximately 54 inches square and this may also be the inside dimension of the main duct at the fan end if a tapered duct is used. In installations of the tapered duct type, the width of the main duct is usually constant and the height tapered uniformly from the full height at the fan house to approximately 10 inches at the small end. The actual height at the small end is determined primarily by the width of the metering crack and the size of lumber used. If 6-inch boards are used in this example, the height at the small end would be 6 inches plus the width of the metering crack (4½ inches) or 10½ inches.

Conclusions

Each hay drier is an individual problem and each unit must be tailored to fit the particular set of conditions encountered. Proper design is obviously essential, but the ultimate key to overall successful operation of the system is proper management. Since design conditions and management factors vary throughout the country, the latest design and management recommendations should be checked with either the extension service or the experiment station of the state Agricultural College.

Flow and Fan—

Principles of Moving Air through Ducts

C. HAROLD BERRY

Gordon McKay Professor of Mechanical Engineering, Harvard University

Part 4. Losses in Diverging Passages

The discussion of friction losses in duct systems continues, in this fourth part of a twelve-part series, with the subject of friction and shock losses in passages of increasing area.

IT IS often desirable or necessary to enlarge the cross-sectional area of a duct in the direction of flow. Perhaps the commonest reason for doing this is to reduce the velocity and thereby "convert" the reduction in velocity pressure into an increase in static pressure. Another obvious situation is the discharge of air from a duct into a room.

We may express the results of the expansion in various terms. One method is to state the loss due to the expansion. This loss is a shock loss, arising from the impact of the rapid jet from the small duct as it collides with the slower-moving air in the large duct downstream. Another method is to state the corresponding rise in static pressure; the static pressure in the large duct will (in most cases) be higher than the static pressure in the small duct. This rise in static pressure accompanies the reduction in velocity pressure, but will often be smaller. Accordingly, the third method of stating the results is to evaluate the "efficiency" of the expansion, which is the ratio of the rise in static pressure to the drop in velocity pressure.

The duct expansion may be abrupt or tapering. If tapering, the included angle may be anything from zero to 180 degrees (which is the abrupt expansion).

Naturally, the shock loss is not the only loss. There is also the usual friction of the confining walls. In some expansions, this is negligible, but in others it may be relatively large. It must be considered.

So we have several items to discuss.

Nomenclature and a Little Algebra

We shall denote the upstream duct by the subscript 1, and the downstream by 2. The ratio of areas, small over large, we shall denote as r. This is also the inverse ratio of the velocities, since the volume flowing is constant.

$$r = \frac{A_1}{A_2} = \frac{V_2}{V_1} = \left(\frac{D_1}{D_2}\right)^2 \tag{94}$$

The value of r ranges from unity for a straight duct, with no change in velocity, to zero for a duct discharging into a space large enough to be regarded as virtually infinite, where the velocity will be virtually zero. The ratio of diameters obviously applies only to circular ducts.

Since the velocity pressure, in whatever units, is proportional to the square of the velocity, the ratio of the velocity pressures at 2 and 1 will be r^2, and the drop in velocity pressure may be expressed in terms of either the initial or the final velocity pressure.

$$\frac{h_{v2}}{h_{v1}} = r^2 \tag{95}$$

$$h_{v1} - h_{v2} = h_{v1}\left[1 - \frac{h_{v2}}{h_{v1}}\right] = h_{v1}\left[1 - r^2\right]$$

$$= h_{v2}\left[\frac{h_{v1}}{h_{v2}} - 1\right] = h_{v2}\left[\frac{1}{r^2} - 1\right] \tag{96}$$

$$= h_{v2}\left[\frac{1 - r^2}{r^2}\right]$$

In the preliminary discussion of abrupt expansion in Part 1 we have already developed the shock loss (the Borda loss) which is the drop in total pressure.

$$h_L = \left[\frac{V_1 - V_2}{4000}\right]^2 \tag{97}$$

$$= \left[\frac{V_1}{4000}\right]^2\left[1 - \frac{V_2}{V_1}\right]^2 = h_{v1}\left[1 - r\right]^2$$

$$= \left[\frac{V_2}{4000}\right]^2\left[\frac{V_1}{V_2} - 1\right]^2 = h_{v2}\left[\frac{1}{r} - 1\right]^2 \tag{98}$$

$$= h_{v2}\left[\frac{1 - r}{r}\right]^2$$

where h_L is in inches of water, V in fpm, $\rho = 0.075$ lb per cu ft.

We have also developed the value of the increase in static pressure in abrupt expansion, the static pressure regain.

$$h_{s2} - h_{s1} = \frac{V_2\,(V_1 - V_2)}{8 \times 10^6} \tag{99}$$

$$= 2\left[\frac{V_2}{4000}\right]^2\left[\frac{V_1}{V_2} - 1\right] = h_{v2}\,2\left[\frac{1}{r} - 1\right]$$

$$= h_{v2}\,2\left[\frac{1 - r}{r}\right] \tag{100}$$

$$h_{v1}\,2\,r^2\left[\frac{1}{r} - 1\right] = h_{v1}\,2r\left[1 - r\right]$$

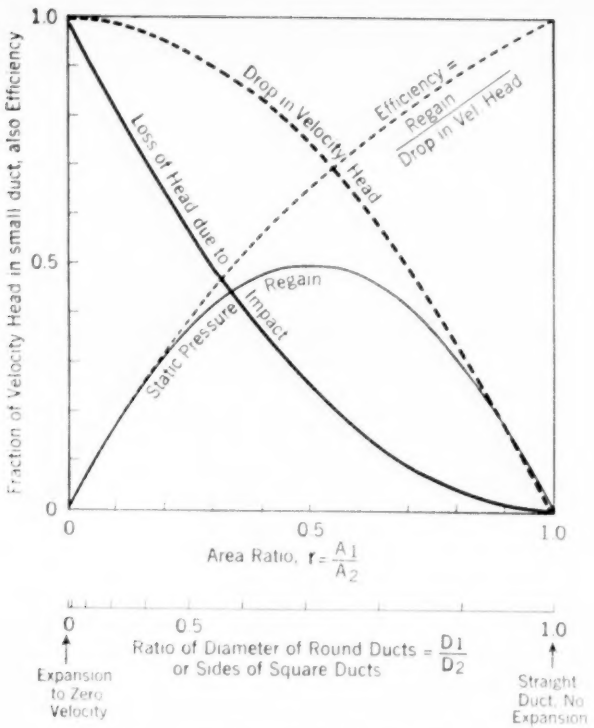


Fig. 17. Characteristics of abrupt expansion.

These equations are not recommended for routine computations; the basic equations (97) and (99) are easy to handle in numerical work. The expressions in terms of the ratio are convenient for algebraic studies.

It should be mentioned that the foregoing expressions are significant only for values of r between zero and unity. Negative values of r are obviously impossible, and values larger than unity correspond to a duct that decreases in size, a situation in which an entirely different flow pattern appears, with different relationships and a different method of expressing them.

Abrupt Expansion

We have already (in Part 1) worked out the basic results for abrupt expansion.

$$\text{Drop in velocity pressure} = \left(\frac{V_1}{4000}\right)^2 - \left(\frac{V_2}{4000}\right)^2 \quad (101)$$

$$\text{Rise in static pressure} = \frac{V_2\ (V_1 - V_2)}{3 \times 10^6} \quad (102)$$

$$\text{Drop in total pressure} = \text{Loss due to shock} = \left(\frac{V_1 - V_2}{4000}\right)^2 \quad (103)$$

All of these expressions are for pressures in inches of water, velocities in fpm, and density = 0.075 lb per cu ft.

We have just expressed these items in terms of the area ratio

$$h_{v1} - h_{v2} = h_{v1}\ (1 - r^2) = h_{v2} \left(\frac{1 - r^2}{r^2}\right) \quad (104)$$

$$h_{s2} - h_{s1} = h_{v1}\ 2r\ (1 - r) = h_{v2}\ 2 \left(\frac{1 - r}{r}\right) \quad (105)$$

$$h_{L,\ 1,2} = h_{v1}\ (1 - r)^2 = h_{v2} \left(\frac{1 - r}{r}\right)^2 \quad (106)$$

The efficiency of the abrupt expansion is the ratio of the static pressure regain to the drop in velocity pressure.

$$\text{Efficiency} = \frac{2r}{1 + r} \quad (107)$$

In Fig. 17 are curves showing how these quantities vary with the ratio of areas. The values in terms of h_{v1} seem of most interest. Our point of view is usually that the abrupt expansion is intended, among other things, to utilize the velocity pressure for the production of a rise in static pressure. In a sense, the initial velocity pressure is what is given to the abrupt expansion, and what the abrupt expansion does with it is the result attained.

It will be noted that when the area ratio is 0.5, that is, when the duct expansion is to double the initial area, the static pressure regain has a maximum value, one half of the initial velocity pressure. The efficiency is then $\frac{2}{3}$. The area increases from 1 to 2, the velocity drops from 1 to $\frac{1}{2}$, the velocity pressure drops from 1 to $\frac{1}{4}$, a drop of $\frac{3}{4}$. The static pressure regain of $\frac{1}{2}$ is $\frac{2}{3}$ of $\frac{3}{4}$. The results check.

When the ratio is unity, the efficiency is 1, but the regain is zero, as is also the drop in velocity pressure. The high efficiency with larger values of the ratio indicates that the regain is a large fraction of the drop in velocity pressure, but the latter is rapidly decreasing, so that the regain is a growing fraction of a shrinking quantity, and itself approaches zero. So in designing an abrupt expansion, we must not confine our attention to its efficiency.

Tapering Enlargements

In an expanding taper of very small included angle there is virtually no shock loss. The rise in static pressure equals the drop in velocity pressure, except for the reduction due to duct-wall friction, as indicated by Bernouilli's equation. In the long expanding taper, this wall friction may be significant.

As the included angle of the expanding taper increases, the length of the taper decreases, and the duct wall friction decreases, while the shock loss increases.

We shall undertake to formulate the wall friction and the shock loss for expanding tapers.

The initial and final diameters, or the initial diameter and the area ratio r, the length of the taper, and the included angle, are related.

$$D_2 - D_1 = L\ 2 \tan \frac{\theta}{2} = D_1 \left(\frac{D_2}{D_1} - 1\right) = D_1 \left(\frac{1}{\sqrt{r}} - 1\right) \quad (108)$$

Where symbols are as shown in Fig. 18.

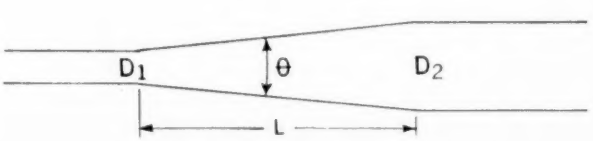


Fig. 18. Tapering enlargement.

We have already seen (equation 78) that in circular ducts the friction loss is proportional to the square of the quantity and inversely proportional to the fifth power of the diameter. In the expanding taper, the quantity is constant, but the diameter increases. A uniform duct of suitable diameter, whose length equals the length of the expanding taper, will have the same friction drop. What is the diameter of that equivalent uniform duct?

The method is obviously to formulate the differential friction drop in terms of fLQ^2/D^5 where the diameter is a linear function of the distance along the duct, to integrate, and to equate the result to the friction drop in a uniform circular duct. Like terms cancel, and yield a value for the diameter of the equivalent uniform duct, which has the same friction as the taper enlargement. The equivalent uniform duct has the same length as the taper, and carries the same *quantity* of the same gas. If D_u is the diameter of this equivalent uniform duct,

$$D_u = D_1 \left[\frac{4}{(1 + r)\ (1 + \sqrt{r})\ \sqrt{r}} \right]^{1/5} \qquad (109)$$

This formulation is perhaps valid for enlarging tapers of small included angle. For larger included angles, the validity of the assumptions becomes less secure, but for wide-angle tapers, the length is short and the friction loss is small, becoming negligible as the included angle rises above perhaps 30 degrees. At the same time, as the included angle increases, the shock loss increases rapidly, and dominates for larger angles.

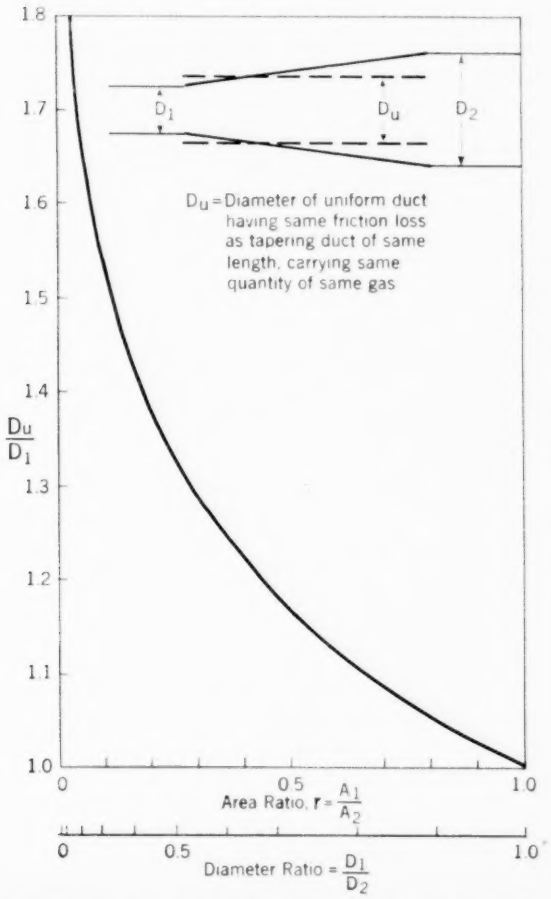


Fig. 19. Straight duct equivalent to tapered enlargement.

When r = 0 we have expansion to zero velocity, that is, the duct discharges into a large space. Beyond the end of the duct there is no wall friction, since there are no walls. Accordingly, the diameter of the equivalent uniform duct is infinite, corresponding to zero friction drop. When r = 1, we have no expansion at all, but a simple uniform duct; the diameter of the equivalent duct is obviously the same as that of the given duct. The curve in Fig. 19 shows the relationship.

For a given taper, the length will be known, or can be computed from equations (103). This will be the length of the equivalent uniform duct. From the curve we can find the diameter of the equivalent uniform duct. Then from any chart for circular ducts we can find the friction loss, which will be the same for the tapering duct as for the equivalent uniform duct.

The same relationships apply for either direction of flow, that is, the foregoing table and resulting curve are probably equally applicable to expanding tapers and to reducing tapers, with perhaps about the same degree of uncertainty as the included angle increases.

Tapering ducts of rectangular cross section appear in a wide variety of forms. Transformation pieces connecting rectangular and round ducts are common. The computation of the friction loss in such elements is not easy. In most cases such an element will be a small portion of the entire duct system, so that a large error in estimating its individual friction loss will be a small error in the aggregate friction loss of the entire duct system.

Perhaps it may suffice to find the diameter of the equivalent circular duct (for the same *quantity*) for each of the end sections, from these to find the diameter of the equivalent uniform duct, and to compute the friction loss for this uniform round duct.

This method is open to objection on the ground that rectangular tapers are not equivalent to circular tapers. In a circular taper (that is, a frustum of a cone) the diameter progresses linearly and the area as the square of the diameter. In a rectangular taper (which may be the frustum of a pyramid or something worse) the area does not progress in so simple a fashion. In some cases the rectangular taper is equivalent to a round taper whose sides bulge like the staves of a barrel. Sometimes this bulge is so pronounced that intermediate areas exceed the area at either end, so that the connector expands from the entrance and contracts to the exit.

A general method may be outlined that can be applied to any rectangular connector. It starts with equation (74), Part 1, which may be written

$$h_L = f\ L\ \rho\ \frac{V^2}{2g}\ \frac{a + b}{2ab} \qquad (109.1)$$

Substituting the value of $V = \dfrac{Q}{ab}$

$$h_L = \frac{f\ L\ \rho\ Q^2}{2g}\ \frac{a+b}{2a^3b^3} \qquad (109.2)$$

For any section of the rectangular taper, the contribution to the friction loss can be formulated as

$$dh_L = \frac{f\ \rho\ Q^2}{2g}\ \frac{a + b}{2a^3b^3}\ dx \qquad (109.3)$$

where x is the axial dimension of the taper, measured from one end.

With the cross-section dimensions a and b expressed as functions of the distance x, this equation can be integrated to give the friction loss of the entire taper.

This friction loss can in turn be equated to the loss in a circular duct carrying the same quantity, as given by equation (78).

The equality of the two resulting expressions may be solved for D_{uq} which is the diameter of a uniform round duct having the same friction loss as the given tapering rectangular tapering duct of the same length, carrying the same quantity of the same gas. In some cases this is easily evaluated; in other cases it presents great difficulties.

It should be noted that this method of integrating the friction loss in a taper is mathematically sound, but that the result can be no better than the assumptions underlying it. It assumes that the friction loss is proportional to the hydraulic mean radius for ducts of whatever proportions. It neglects the effect of varying Reynolds number, that is, the coefficient f is assumed to be constant. It omits consideration of shock and contraction losses, which may be important for tapers of large included angle. The result commands little confidence. An integral sign provides no guarantee of dependable results from ill-founded assumptions.

It may nevertheless be interesting to present results for two simple cases.

A common case is a rectangular taper with two sides parallel; dimension a is constant, b increases from b_1 to b_2. The diameter of a uniform round duct having the same friction loss is given by

$$D^5_{uq} = \left(\frac{4}{\pi}\right)^2 \frac{4\ a^3\ b_1^2\ b_2^2}{a\ b_1 + a\ b_2 + 2b_1b_2} \qquad (109.4)$$

Another case is a rectangular taper connecting two ducts of the same ratio of dimensions, b/a (a being the short side) in which both dimensions increase in the same ratio, $\left(\frac{a_2}{a_1}\right)$. In this case

$$D^5_{uq} = a^5_1 \left(\frac{4}{\pi}\right)^2 \left[\frac{2(b/a)^3}{(b/a) + 1}\right] \left(\frac{4}{\left[1 + \left(\frac{a_1}{a_2}\right)^2\right]\left[1 + \left(\frac{a_1}{a_2}\right)\right]\left(\frac{a_1}{a_2}\right)}\right)$$

$$= b^5_1 \left(\frac{4}{\pi}\right)^2 \left[\frac{2(a/b)^3}{(a/b) + 1}\right] \left(\frac{4}{\left[1 + \left(\frac{a_1}{a_2}\right)^2\right]\left[1 + \left(\frac{a_1}{a_2}\right)\right]\left(\frac{a_1}{a_2}\right)}\right) \qquad (109.5)$$

The results of these two cases have been compared with the simple procedure suggested above, namely, finding the diameters of equivalent round ducts and the diameter of the uniform round duct equivalent to the corresponding round taper. The simple result differs from equation (109.4); in one numerical case it was about twenty percent low. For the case formulated by equation (109.5) the results are identical.

It is easy to set up rectangular tapers for which the solution runs into the utmost complexity.

As has been remarked, a taper is usually a small part of a duct system, and a rough estimate of its friction loss will introduce slight error in the aggregate loss of the entire system. Thus it appears unnecessary to go through elaborate computations such as have been outlined. It appears that it should suffice to use the simpler process, but it must be borne in mind that this may yield results far from the truth. However, the truth is hard to forecast: the foregoing discussion certainly does not command confidence. When the truth is not ascertainable, a good guess must be accepted. The simple method is therefore repeated here as a suggested method of guessing:

(1) Find the diameters of the round ducts equivalent to the entrance and exit sections of the taper, for the same quantity flowing. This is readily done from the upper curve of Fig. 16.

(2) Find the diameter of the uniform round duct having the same friction loss as the round taper defined by the diameters found in (1). This is found from the curve of Fig. 19.

(3) With the diameter of the equivalent uniform round duct found in (2) and the given *quantity* of gas flowing, and the known length of the taper under consideration, find the friction loss from any chart such as Fig. 14, Part 3, for the loss in a round duct.

Shock Loss in Tapering Enlargements

Reports of experimental work in this field are divergent. It is believed that the most reliable data are those presented by A. H. Gibson, Proceedings of the Royal Society of London, vol. 83 (1910), page 366, and Engineering (London) Feb. 16, 1912, page 205. These original papers are well worth reading and study; they present many details that are not mentioned here. Gibson's results (from observations on water in small pipes) have been confirmed for air by Kratz and Fellows (University of Illinois, Engineering Experiment Station, Bulletin 300, Feb. 25, 1938), whose report is also well worth reading and study. (It should be noted that Kratz and Fellows in their Fig. 18 reproduce one of Gibson's curves with a gross error of plotting.)

A convenient base for expressing the shock loss in a diverging taper is the Borda loss (for abrupt expansion) for the same area ratio. We have already formulated this as

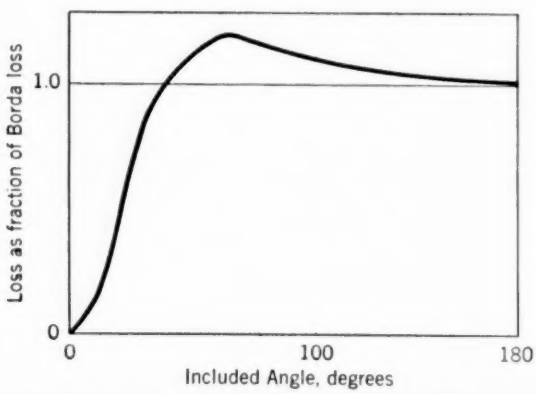


Fig. 20. Shock loss (no friction) in round diverging tapers as a fraction of Borda loss in abrupt expansion, from A. H. Gibson.

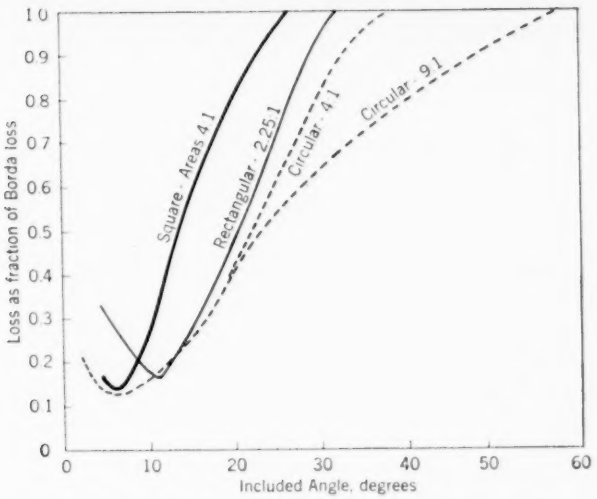


Fig. 21. Total loss, friction and shock, in diverging tapers as a fraction of Borda loss, from A. H. Gibson.

$$h_{LB} = \left(\frac{V_1 - V_2}{4000} \right)^2 \qquad (110)$$

Gibson reports the loss in diverging tapers as a fraction of this Borda loss, for circular, square, and rectangular expanding tapers, of various included angles between opposite sides. The curves in Fig. 20 and 21 are copied from Gibson.

The curve in Fig. 20 covers the entire range of angles from zero (straight cylindrical duct) to 180 degrees (abrupt expansion). It shows that for a taper of circular cross-section, as the angle increases from zero, the loss increases from zero, and that (somewhat to our surprise) when the included angle reaches about 40 degrees the loss is equal to that in abrupt expansion. For larger included angles, the shock loss in the taper exceeds that in the abrupt expansion (by over 20% for an angle of 63 degrees). Since it would be foolish to spend money making a taper enlargement giving a larger loss than an abrupt expansion, we are not interested in tapers with included angle greater than about 40 degrees.

The curves in Fig. 21 show Gibson's results for various ducts, circular, square, and rectangular. These include both friction loss and shock loss. As the angle decreases, the length of the taper increases, wherefore the wall friction increases as the shock loss decreases. Accordingly, the aggregate loss passes through a minimum value at an included angle ranging from 6 degrees for circular and square ducts to 11 degrees for a rectangular taper with two sides parallel.

Gibson shows that the area ratio has some influence on the percent of Borda loss found for the tapers.

The curves as presented in Fig. 21 indicate that there is a considerable range of variation among the various forms of ducts and the various values of area ratio. Accordingly, the estimation of the aggregate friction and shock loss in enlarging tapers is hardly subject to precise computation. But these are the best data we have.

The difference shown by Gibson's curves for the circular and the square duct may be explained in part, Gibson suggests, by remarking that a square duct with a given angle between its opposite plane sides may be equivalent to a circular taper of somewhat larger angle. The point is that the angle between diagonally opposite corners of a square pyramid is greater than the angle between the centerlines of opposite sides.

This suggestion, however, is entirely qualitative, and is of no practical value, since the flow pattern in a square duct shows disturbances in the corners that have no counterpart in the circular duct.

Gibson discusses an interesting design of duct enlargement whereby space and cost can be reduced, with only a slight increase in loss. He suggests a short tapering enlargement followed by an abrupt enlargement. This is much better than a taper connecting the same two areas in the same length, because the smaller angle of the taper gives smaller loss therein, not only because the percent of the Borda loss is smaller, but also because the Borda loss itself is smaller. At the same time, the reduced velocity at outlet from the taper reduces the loss due to abrupt expansion. Gibson suggests that, "the total loss is a minimum with a pipe in which the angle of divergence is little, if any, greater than that giving a minimum loss in the diverging portion alone. It thus becomes possible to design a pipe—often with a considerable reduction in length—in which the boundaries are straight, and in which the loss is still appreciably less than in a straight taper pipe giving the full enlargement of section with the best possible value of the included angle."

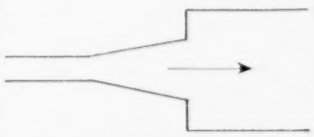


Fig. 22 Gibson Enlargement.

Gibson continues: "In any cases likely to occur in practice the value of the included angle may be taken as follows, without any very great variation from conditions of maximum efficiency:

Area ratio	10:1	4:1	2:1
Included angle (circular pipe)	10 deg	12.5 deg	16 deg
Included angle (rectangular pipe)	7 deg	10.5 deg	15 deg

"By this method of construction the loss may be reduced to about 90% (in rectangular pipes), and to about 96% (in circular pipes) of the minimum possible loss in a uniformly tapering pipe undergoing the full enlargement of section."

It is interesting to pursue Gibson's suggestion a little further. Unfortunately the only feasible approach seems to be the computation of numerous cases. The author has computed forty-five cases (for five values of the included angle and nine values of the diameter ratio) and finds it difficult to summarize the results in any simple statement. A few examples, however, give some idea of the possibilities.

Fig. 23 shows the results for a single rather extreme case, in which a round duct one foot in diameter is connected to a round duct five ft in diameter. The rate of flow is taken as 3144.5 cfm to make the arithmetic easy.

Abrupt expansion from 1 to 5 ft diameter shows a loss of 0.922 inches of water. Gibson's data indicate that a 12-degree taper from 1 to 5 ft diameter will show a loss which is 20% of this, i.e., 0.184 inches of water; such a taper will be a bit more than 19 ft long. The combination of a shorter taper with an abrupt expansion, suggested by

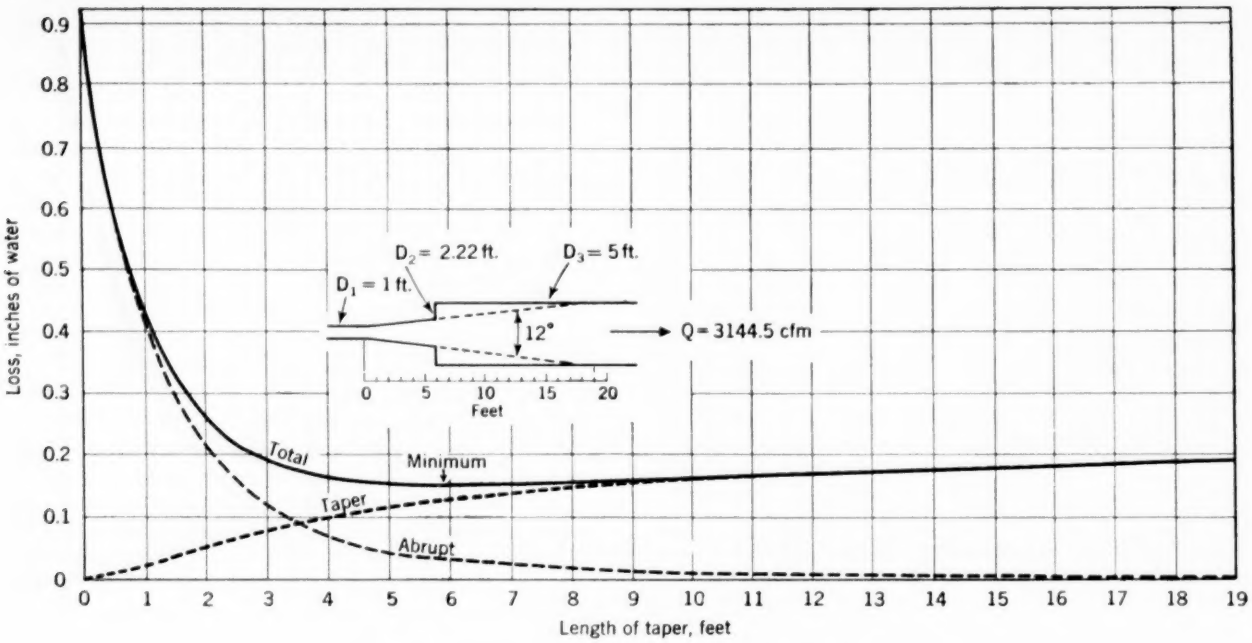


Fig. 23. Losses in abrupt and tapered enlargements.

Gibson, shows a loss that decreases to a minimum value of 0.154 inches of water when the taper is about 5.8 ft long, and increases slowly for longer tapers. This result is typical. A taper considerably shorter than the full-length taper connection, followed by an abrupt expansion from the end of the short taper to the exit duct, entails a loss much smaller than that of an abrupt expansion, and somewhat smaller than the loss produced by the full-length taper.

The very rapid drop in loss as the taper increases from zero to three or four feet is striking. The dotted curves of Fig. 23 show how this is made up of the shock-plus-friction loss in the taper which increases slowly as the length of the taper increases, and the shock loss of the abrupt expansion, which decreases rapidly as the minor diameter of the abrupt expansion increases. The slow increase of the loss in the taper is readily understood when it is remembered that the diameter is increasing and that the loss due to friction varies inversely as the fifth power of the diameter.

The rapid decrease in the abrupt expansion loss is due to the fact that not only is the area ratio (small over large) rising toward unity, but also the inlet area is increasing and hence the inlet velocity is decreasing inversely as the square of the diameter and hence faster than the square of the length of the taper. In equation (98) we formulated the abrupt expansion loss as

$$h_L = h_{v1}\,(1 - r)^2 = \frac{Q^2}{2g\left(\frac{\pi}{4}\right)^2 D_1^4}\left[1 - \left(\frac{D_1}{D_2}\right)^2\right]^2$$

In the combined expansion both factors in this expression decrease. The inlet velocity head falls off with the square of the velocity and hence inversely as the fourth power of the minor diameter. The factor involving the ratio of areas also decreases because the ratio r is increasing with the square of the minor diameter. Accordingly, it should be no surprise to discover that the abrupt expansion loss decreases rapidly as the taper is extended. That a minimum total loss is reached arises from the addition of the two losses, the taper loss increasing and the abrupt loss decreasing.

TABLE 3—COMPARISON OF FULL LENGTH AND PARTIAL TAPERS

Taper Angle = 12 degrees; D_1 = 1 foot; Q = 3144.5 cfm

Exit diameter, D_2, feet	1.2	1.4	1.6	1.8	2	2.5	3	4	5
Abrupt expansion loss, inches of water	.093	.240	.371	.478	.563	.706	.790	.879	.922
Full-length taper									
Length, feet	0.95	1.90	2.85	3.81	4.76	7.14	9.51	14.27	19.03
Loss, inches of water	.019	.048	.074	.096	.113	.141	.158	.176	.184
Combination taper and abrupt for minimum loss									
Approx. length of taper	0.8	1.4	2.1	2.4	3	4	5	5	6
Loss, inches of water	.016	.040	.063	.080	.094	.118	.132	.147	.154

TABLE 4—INFLUENCE OF TAPER ANGLE ON LOSSES

	Included Angle of Taper, Degrees				
	6	8	10	12	14
Full length taper loss factor, % of abrupt	13.2	14.5	17.0	20.0	24.6
Combined taper and abrupt expansion for minimum loss, % of abrupt	11.7	12.7	14.6	16.7	19.8
% of full-length taper	88.6	87.6	85.9	83.5	80.5

It is worth noting that the curve of total loss shows a very flat minimum, indicating that the length of the taper is not critical; any value between 5 and 7 ft will yield a loss differing only slightly from the minimum. This is typical of all the cases studied.

A summary of results for this kind of combined expanding connection with a taper having a 12-degree included angle is given in Table 3 for an inlet diameter of 1 foot and a final outlet diameter ranging from 1.2 ft to 5 ft (the latter being the case depicted in Fig. 23). In this table the length of taper yielding the minimum loss is given only approximately; we have already remarked that it is not critical. It is evident from this table that a sharp reduction in loss can be attained by providing a short length of taper, especially for the larger outlet diameters. For the smaller outlet diameters, up to perhaps 2 ft, the difference between the full taper and the combined taper-and-abrupt expansion is small, and the length of the full taper is small, nevertheless it remains true that if the taper is cut short the loss is reduced. For the larger outlet diameters the reduction in length is considerable and the reduction in loss becomes larger.

The influence of the included angle of the taper is set forth in Table 4. This table has as its base the loss computed for an abrupt expansion from the inlet diameter to the final outlet diameter (with no taper). The first line gives Gibson's factor by which this abrupt loss is to be multiplied to secure the loss in a full-length taper from the inlet diameter to the outlet diameter. The second line gives the factor by which the abrupt loss is to be multiplied to secure the minimum loss in a combined taper-and-abrupt expansion of optimum dimensions. The third line gives the ratio of the first two, which is the ratio of the loss in the combined taper-and-abrupt connection to the loss in a full-length taper connection. It is interesting to note that these ratios are functions of the included angle of the taper, and apply to all diameter ratios, at least up to fivefold.

While it is hardly possible to give complete results for all combinations of included angle, diameters, rate of flow, round and rectangular ducts, and the like, it is hoped that enough has been said to indicate that substantial savings can sometimes be achieved. It is laborious, but not difficult, to compute results for any specific case and to locate the dimensions yielding minimum loss, and it is believed that the effort is well justified.

The method of computing is straightforward, and is conveniently carried out in a tabulation in which the lines are assigned various values of the length of the taper and the columns the intermediate and final computed quantities. If D_1 denotes the inlet diameter, D_2 the diameter at the end of the tapered portion, and D_3 the final outlet diameter, all in feet, the successive columns of the table record

(1) L, the length of the taper, in feet, starting from zero and advancing by rather small steps until the point of minimum loss is reached.

(2) $D_2 = D_1 + L\ 2 \tan \frac{\theta}{2}$ where θ is the included angle of the taper, chosen as suggested by Gibson, quoted above.

(3) $1/D^2_2$, the reciprocal of the square of the diameter at the end of the taper. (An intermediate column for D^2_2 may be convenient; much depends upon the method of computing.)

(4) $1/D^2_2 - 1/D^2_3$ Note that D_3 is a constant.

(5) $1/D^2_1 - 1/D^2_2$ Note that D_1 is a constant.

(6) The square of the quantity in column (5). This square is proportional to the abrupt expansion loss from D_1 to D_2 which is the basis for computing the taper loss by means of Gibson's factor, which is a function of the included angle and the shape of the duct, round or rectangular.

(7) The loss factor for the taper of length L which is the quantity in column (6) multiplied by the factor taken from Gibson's curves corresponding to the included angle of the taper and the shape of the duct, round, rectangular, etc.

(8) The loss factor for the abrupt expansion following the taper, which is the square of the quantity in column (4).

(9) The total loss factor, which is the sum of quantities in columns (7) and (8).

(10), (11), (12) The losses, taper, abrupt, and total, in inches of water, found by multiplying the quantities in columns (7), (8), (9), respectively, by $Q^2/9{,}888{,}000$, the square of the rate of flow, in cfm, divided by 9,888,000. (Perhaps 10,000,000 might be close enough.)

Abrupt Expansions in Series

An interesting side light on Gibson's suggestion is afforded by a study of the loss in two abrupt expansions in series. The results indicate that the substitution of two abrupt expansions, Fig. 24-A, for a single abrupt expansion, Fig. 24-B, may reduce the total loss to one half.

Fig. 25 gives the optimum dimensions. For example, with $D_1 = 2$ ft and $D_3 = 5$ ft, if the intermediate diameter, D_2 is taken as $2 \times 1.313 = 2.63$ ft, the total shock loss in Fig. 24-A will be one half that in Fig. 24-B.

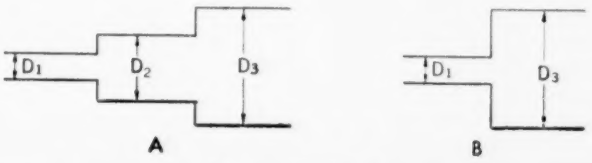


Fig. 24. Expansions in series.

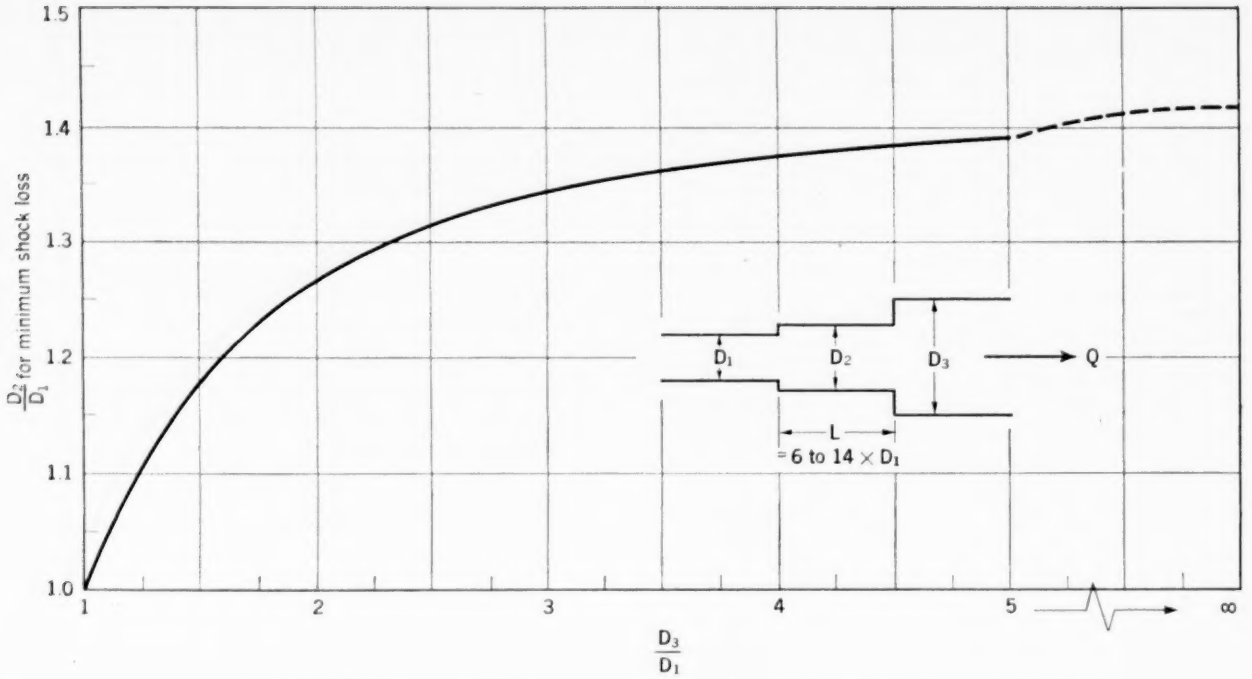


Fig. 25. Diameter ratios for minimum shock loss in series of abrupt expansions.

This is more readily understood by considering the losses in the individual abrupt expansions, from 1 to 2 and from 2 to 3. Fig. 26 shows these losses for the special case $D_1 = 1$ ft, $D_3 = 5$ ft. When D_2 is one foot the passage from 1 to 2 involves no expansion, hence no shock loss, whereas the passage from 2 to 3 is from a diameter of one foot to a diameter of five feet, with maximum loss. As D_2 increases, the loss from 1 to 2 increases and that from 2 to 3 decreases. The shape of these curves reflects the fact that the shock loss due to an abrupt expansion varies differently when its minor or major diameter is altered.

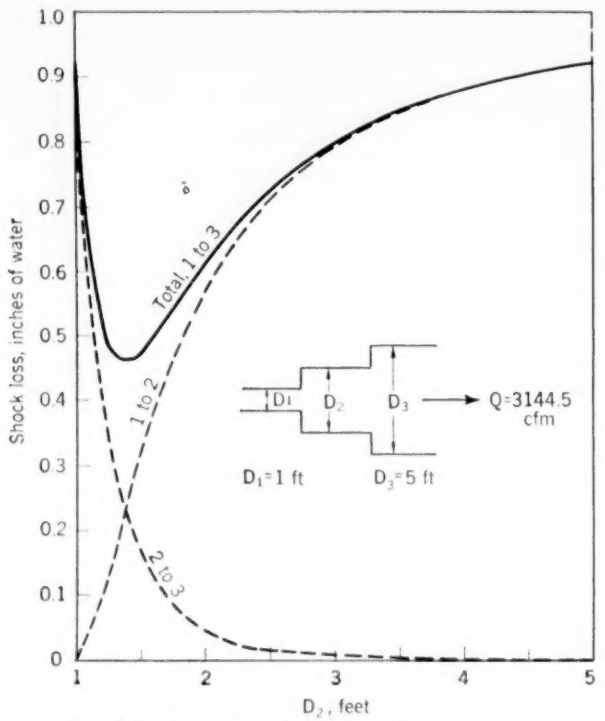


Fig. 26. Component losses in series expansion.

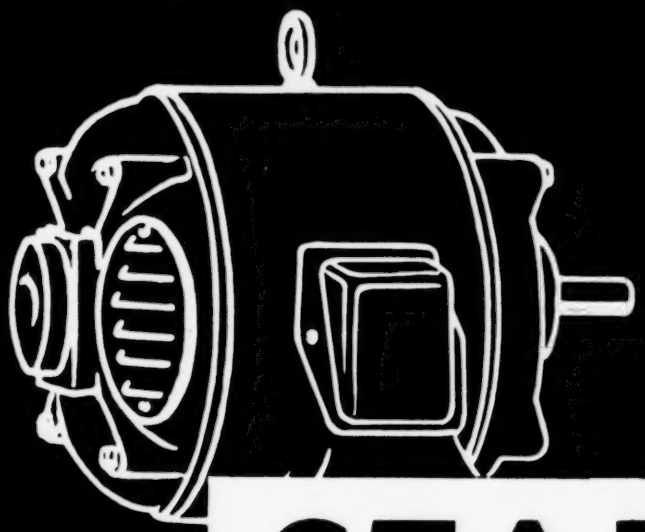
Even for abrupt expansion to zero velocity this same sort of relation holds. If the diameter of the intermediate duct is made equal to the diameter of the entrance duct multiplied by the square root of 2, which is 1.414, the loss will be reduced by one-half. In Fig. 27, the loss in case A will be half the loss in case B.

Fig. 27. Series expansion to zero velocity.

All of this assumes that the length of the intermediate duct of diameter D_2 is sufficient to develop the full static pressure regain following the abrupt expansion from 1 to 2. The necessary intermediate length seems not to be definitely established; it appears that at least 6 times D_1 is needed, and that more than 14 times D_1 gives no additional advantage. The friction loss in this intermediate duct has not been included in the computed loss.

It should be understood that this discussion of Gibson's combined taper-and-abrupt expansion and of two abrupt expansions in series is a purely speculative computation based on the simple Borda expression which asserts that the shock loss in an abrupt expansion is proportional to the square of the difference between the average velocities at entrance and exit. Unfortunately, the author has had no opportunity to construct and test ducts designed in this way; he hopes that some reader may have done this or may do it and thus add to our knowledge of duct design.

Losses in converging flow and in fittings will be analyzed in Part 5, to be published next month.



STARTERS

FOR INDUSTRIAL TYPE A-C MOTORS

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Heating and Ventilating Magazines Reference Section

Starters for Industrial Type A-C Motors

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Every electric motor requires a starter to perform the basic functions of starting and stopping the motor and to provide overload protection. Some starters may also perform the additional functions of short circuit protection and speed adjustment. This article discusses in detail the characteristics of a-c motors, their coordination with the characteristics of the driven machinery, and the selection and performance of starters.

LOW voltage, alternating current power is available today in practically all manufacturing plants, commercial buildings, and households. Polyphase a-c induction motors, which are among the simplest and most reliable motors available to machinery builders, represent the bulk of electric motors produced today. Since most motorized drives require no speed control, squirrel-cage motors are used wherever possible, for this type motor contains the least number of parts and hence possesses the greatest degree of reliability. For occasional drives in the heating, ventilating, air conditioning, refrigerating, and related fields, which require speed adjustment, wound rotor motors are normally used.

An induction motor consists of a stationary frame, the stator, which contains the primary winding. Its design is determined by line voltage, number of phases, and number of poles. The rotating member, the rotor, has the secondary winding. The rotor winding consists of bars short circuited by end rings so that no external connections may be made to it. Motors of that type are called squirrel-cage motors. Wound rotor motors have a distributed polyphase winding on the rotor, which is terminated at slip rings. By external connections, for instance by connecting resistors to the slip rings, the electrical characteristics of the rotor circuit may be affected—hence the performance of the motor.

Squirrel-cage Motors

Coordination of motor and drive, as well as the design of a suitable controller, require a knowledge of the relationship between torque and speed of the motor. The speed-torque characteristic of a squirrel-cage motor is determined by its design. Once the motor has been built, its speed as a function of load, and its starting torque, can only be varied to a very limited extent by applying lower than rated voltage to the stator.

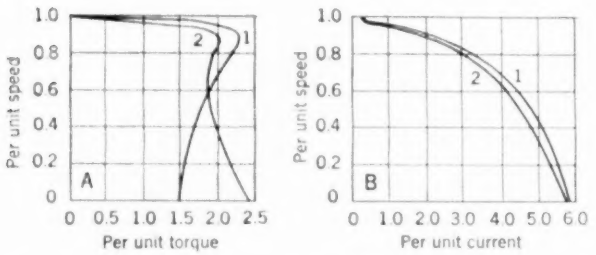


Fig. 1. Characteristic curves of squirrel-cage induction motors; curves 1, normal starting torque motor; curves 2, high starting torque motor.

Starting torque of a squirrel-cage motor is determined by the impedance (apparent resistance of a circuit to alternating current) of the rotor at standstill, which in turn determines the magnitude and phase angle of the secondary current. At standstill, rotor frequency equals line frequency, and rotor impedance contains an appreciable amount of reactance. The amount of starting torque available is determined by the rotor impedance and the ratio of resistance to reactance (that part of the impedance of an a-c current due to capacitance or inductance or both) as only that component of current which is in phase with rotor voltage produces torque. The starting torque can be influenced by the choice of material for the rotor conductors, by variations in the shape of the rotor conductors, or by the use of double cages.

In Fig. 1, speed-torque *A* and speed-current *B* curves are plotted for typical squirrel-cage motors of different rotor designs. Speed, current, and torque are plotted in "per unit," that is, as fractions or multiples of "base values" which are arbitrarily chosen as unity. Base speed is synchronous speed, base torque is rated torque, where

$$\text{Rated torque} = \frac{\text{rated hp} \times 5252}{\text{full load rpm}} = \text{lb-ft}$$

Base current is the rated current at which the motor delivers its rated output.

In Fig. 1, curves 1 in *A* and *B*, apply to a standard normal-starting torque motor. Its rotor consists of a single cage of copper or cast aluminum. Rotor resistance is low, hence slip and running losses at full load are low. The location of the rotor winding close to the air gap results in a low rotor reactance, which accounts for high maximum torque. Starting torque, which is comparatively low, may be less than base torque for large motors.

For applications requiring higher starting torque, motors are available with two squirrel-cage windings in the rotor. One winding, imbedded deeply in the rotor, has low resistance and high reactance. A second winding, located close to the air gap, has high resistance and low reactance. The combined effect of the two rotor windings produces curves 2 in Fig. 1 *A* and *B*. Slip and running losses are slightly higher; maximum torque and starting current are somewhat lower than for normal-starting torque motors. Starting torque, however, is considerably increased.

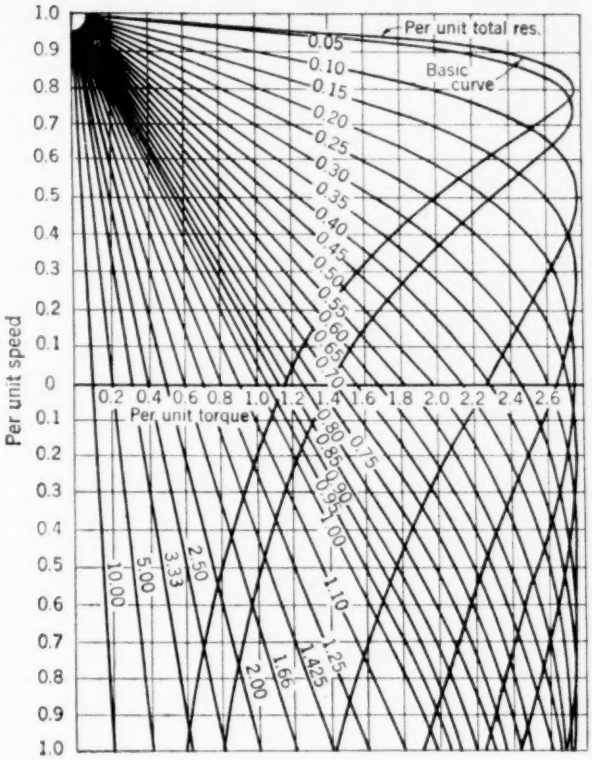


Fig. 2. Speed-torque curves of a typical wound rotor motor.

Although the curves of Fig. 1 are typical and bring out the salient features of different types of squirrel-cage motors, specific values of maximum torque, starting torque, and starting current vary somewhat with speed and frame size of different motors.

Figure 1 indicates that the starting (or locked rotor) current of squirrel-cage motors is of the order of six times normal current. Switching devices used for starting squirrel-cage motors must be capable of making and breaking locked rotor current* of the motor with which they are used. A locked rotor current of six times normal is encountered with most general purpose squirrel-cage motors. However, some motors have higher locked rotor currents, especially two-pole motors, which have locked rotor currents of the order of ten times full load current. Special purpose motors may have still higher locked rotor currents.

Wound Rotor Motors

When its slip rings are shortcircuited, the speed-torque curves of a wound rotor motor are similar to those of a squirrel-cage motor. However, when resistance is connected to the slip rings, and in series with the secondary winding, the secondary voltage drop is increased. Consequently, the slip must increase so that the voltage generated in the rotor winding balances the drop across the internal and external rotor resistance.

Speed-torque curves for a typical wound rotor motor with various amounts of resistance connected in the secondary circuit are given in Fig. 2. Resistance values are expressed in per unit of normal secondary resistance which is defined as follows. Normal resistance is that total (internal and external) secondary resistance which obtains a starting torque equal to rated torque. Since the drop across the secondary resistance is proportional to secondary current (or torque), speed varies linearly with load, up to a certain point. The secondary resistance has no effect on motor speed at no load, and speed control by secondary resistance is only obtained when the motor is loaded.

To lay out a secondary resistor for speed control, obtain normal secondary ohms from the motor designer. If this cannot be done, normal secondary ohms for a three-phase motor can be calculated from rated horsepower and rated secondary current, which are stamped on the motor nameplate, from the following formula:

Normal secondary ohms =

$$\frac{249 \times \text{rated hp}}{0.97\ (\text{rated secondary current})^2}$$

This formula is based on the assumption that motor slip is 3% at full load, which holds true for most smaller and medium sized motors.

A chart similar to Fig. 2 can then be used to determine the total secondary resistance in per unit which is required to obtain a given speed reduction at a given load. The external resistance is equal to the total resistance less the slip, which is of the order of 0.03 per unit. As an example, Fig. 2 indicates that, to obtain a speed of 0.6 at a torque of 0.8, resistance of 0.50 is needed. The external portion is $0.50 - 0.03 = 0.47$.

Load Characteristics

On drives requiring no speed adjustment, which are generally powered by squirrel-cage motors, it is not too important to know how the load on the motor varies with speed as long as the load at full speed is known which is the basis for selection of motor size. When the motor is connected to the line, it simply accelerates to its full speed in accordance with its inherent speed-torque characteristic. However, when a wound rotor motor is used on a drive requiring speed adjustment, it is necessary to know the speed-torque curve of the load, in order to select the proper amount of secondary resistance which is needed to obtain a desired speed reduction.

Industrial types of loads fall between two basic load types which are illustrated in Fig. 3. One type is the friction load in which the torque stays constant over the speed

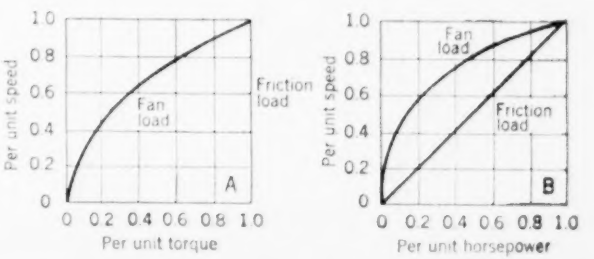


Fig. 3. Basic load characteristics.

* The locked rotor current is the current which is drawn by a squirrel-cage induction motor from the line when the motor is standing still. The locked rotor current is drawn at the instant that a squirrel-cage motor is connected to the line and it thus represents the motor initial starting current. The same amount of current is drawn in case the motor is stalled on account of a mechanical overload.

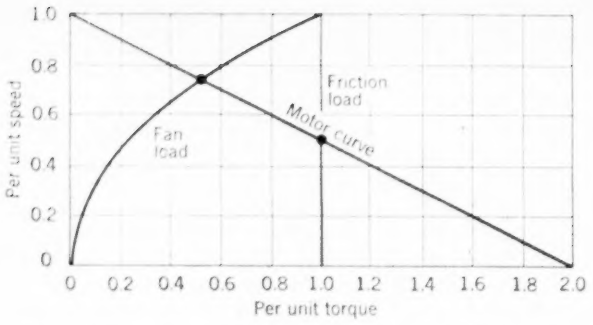


Fig. 4. Effect of load characteristic on speed adjustment.

range, as illustrated at *A* of Fig. 3. The horsepower required for such a drive varies linearly as a function of speed, as indicated at *B* of Fig. 3. Typical examples for this type of load are reciprocating compressors, and constant-displacement piston pumps. Actually, the speed-torque characteristics deviate somewhat from a strictly constant-torque condition because of variations in friction due to housings, and pipes, or ducts. However, for the ranges of speed reductions encountered on actual installations (up to 50%), the assumption of constant torque over the speed range will give the engineer satisfactory operating results.

Another basic load type is that which is required for transporting a viscose fluid. Since a large portion of the energy imparted is utilized for accelerating the fluid, torque varies as the square of the speed, and horsepower varies as the cube of the speed, as illustrated in Fig. 3. Typical examples are fans, hence this type of load is generally called "fan load." If a fan discharges into a large and short duct, or directly into a room, friction is of minor importance, and the actual fans follow the theoretical curve quite closely. It will be noted that the starting torque required is very low since practically only the bearing friction needs to be overcome.

Centrifugal compressors and pumps discharging to atmosphere, when considered only by themselves, also follow the theoretical fan load curves quite well. However, such machines form part of overall systems involving ducts, pipe lines, storage tanks and chambers which impose an appreciable friction load on the drive. Thus, the actual load characteristics of such drives fall somewhere within the area bounded by the theoretical fan load and friction load curves. Pumps and compressors may be started against a considerable back pressure, and the starting torque required may approach full-load torque. In order to lay out the resistor for obtaining a certain speed reduction, it is necessary to obtain from the machinery builder the torque corresponding to the desired operating speed.

How the load characteristic affects the speed reduction obtainable with a given amount of secondary resistance is illustrated in Fig. 4. The motor curve is the speed-torque curve of a wound rotor motor with a secondary resistance of 0.5 per unit of normal secondary ohms. For a friction load equal to full-load motor torque, the motor attains a speed of 0.5 per unit as indicated by the intersection of the motor curve with the friction-load curve. Expressed differently, a speed reduction of 50% is obtained. With a fan load, however, the motor operates at a speed of 0.73, as indicated by the intersection of the motor curve with the fan-load curve. In other words, a speed reduction of 27% is obtained.

To assist in estimating the amount of secondary resistance necessary to realize a certain speed reduction, the per unit speed obtained with a fan load and a friction load is plotted versus per unit secondary ohms in Fig. 5. If only a small amount of speed reduction is desired, it is not too important to know the exact character of the load, and ohms selected on the assumption of a pure fan load will obtain reasonably good results. However, if an appreciable speed reduction is needed, it is essential to know actual motor torque at the reduced speed in order to arrive at a satisfactory resistor layout.

Full-voltage Starters

Since most motor applications do not require speed adjustment, the majority of fans, pumps and compressors are driven by squirrel-cage motors. Any general purpose squirrel-cage motor can be started by simply connecting it to the power supply. As long as the starting torque is larger than the load torque, the motor will accelerate to full speed without further control action. Any limitations preventing full-voltage starting are generally those imposed by the power system which may not be capable of standing the drop due to the starting inrush current, and which may demand reduced-voltage starting.

A full-voltage starter for a three-phase squirrel-cage motor consists of a triple-pole switching element, either manually or magnetically operated, and overload relays in two motor leads. The switching elements must have sufficient thermal capacity so that the contacts and other current-carrying parts will not overheat when they have to carry rated current for 8 hours, which is the equivalent of continuous duty. Standards which enjoy industry-wide acceptance limit the permissible temperature rise of solid contacts to 65C (149F), and the rise of busses, connecting straps and terminals to 50C (122F). It is customary to establish current ratings of switching devices when mounted in the open, so that nothing interferes with the movement of the cooling air around the devices. Starters, however, are generally enclosed in comparatively small cases or boxes which interfere with the effective dissipation of heat into the ambient. Experience has shown that, in general, enclosed switching devices will not overheat when they carry continuously 90% of their open rated current.

Horsepower ratings of general-purpose induction motors are established on the basis that, when carrying full load, their temperature rise will not exceed 40C (104F). Such motors have a service factor of 1.15, which means they can carry 15% more load than their rating without

TABLE 1—STANDARD HP RATINGS FOR FULL-VOLTAGE STARTERS FOR 3-PHASE INDUCTION MOTORS

Starter Size	8-Hour Open Rating, Amperes	Horsepower Rating at		
		110 Volts	220 Volts	440/550 Volts
00	10	¾	1	1
0	15	1½	2	2
1	25	3	5	7½
2	50	7½	15	25
3	100	15	30	50
4	150	25	50	100

injurious heating, although they would exceed the 40C rise. When starters and general purpose motors are coordinated, 90% of their open 8-hour current rating must be not less than 115% of rated motor full-load current. Some motors are rated on the basis of a 50C temperature rise, and such motors do not have a service factor.

In addition to the thermal limitations, which govern the current carrying ability, consideration must be given to the ability of the starter to close on the starting current inrush, and to interrupt the maximum operating overload. In the case of a squirrel-cage motor, the starting current inrush as well as the maximum operating overload are the locked rotor current. Ordinary starters consisting of line contactor and overload relays are not designed to interrupt short circuit current due to a fault in a motor branch circuit, but they must be capable of disconnecting from the line a motor which has been stalled because of mechanical overload. Since most general purpose squirrel-cage motors have a locked rotor current of the order of six times full-load current, Underwriters' Laboratories, Inc. (U/L) test starters for interruption of six times motor full-load current.

Standard ratings for general purpose a-c full-voltage starters are given in Table 1. Size designations 00, 0, 1, etc., have been established by NEMA. Motors of different manufacture and of different speeds vary in their full load currents. Standard starters have sufficient margin in their design so as to be capable of handling the worst motor of a given horsepower rating. For special applications, however, it may be desirable to know the actual motor current and the interrupting ability on which the ratings of the various sizes of standard starters are based. The National Electrical Code lists full-load motor currents which have been agreed to by electric motor manufacturers as being representative of the majority of motors in actual use. These current values form the basis of branch circuit design and selection of conductor size. They have also been recognized as the basis for rating starters with respect to current-carrying and interrupting ability. In Table 2, motor current ratings are listed for standard starters, which correspond to the horsepower ratings given in Table 1. Standard starters have an interrupting ability of six times the current values given in Table 2.

Starters for Hermetically Sealed Motors

A special problem arises when starters are to be selected for motors forming part of a hermetically sealed refrigerating or air conditioning unit. Such motors do not operate in an ordinary ambient, but they are artificially cooled by the refrigerant. Such motors may operate with a higher temperature rise without exceeding the maximum temperature on which the rating of general purpose motors is based. Furthermore, such motors do not operate continuously but intermittently, under automatic control by a thermostat, the longest continuous run is encountered during pull-down.

Hermetically sealed motors are customarily not rated in horsepower, since they are applied on a basis which is quite different from conventional motor ratings. In order to enable an electrical contractor to select a proper starter, the motor full-load current, as well as its locked rotor current, are stamped on the nameplate of the unit. The proper starter may then be selected with the aid of Table 2, so that the stamped motor current does not exceed the 8-hour enclosed starter rating, and the stamped locked rotor current does not exceed six times the motor current rating as given in the table. Since the pull-down period may be of sufficient length to let the starter attain its ultimate temperature rise, no allowance is made in the starter selection for intermittent operation of the motor.

TABLE 2—STANDARD MOTOR CURRENT RATINGS FOR FULL-VOLTAGE STARTERS FOR 3-PHASE INDUCTION MOTORS

Starter Size	8-Hour Rating in Amperes		Motor Current Rating in Amperes at			
	Open	Enclosed	110 Volts	220 Volts	440 Volts	550 Volts
00	10	9	5.6	3.5	1.8	1.4
0	15	13.5	10	6.5	3.3	2.6
1	25	22.5		15	11	9
2	50	45		40	32	26
3	100	90		78	52	41
4	150	135		125	123	98

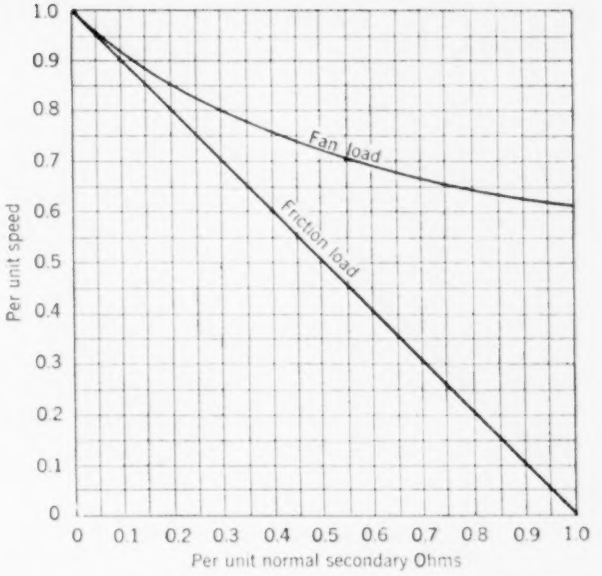


Fig. 5. Wound rotor motor performance for friction and fan loads.

Manual Full-voltage Starters

Manual starters are the most inexpensive starters available. A typical starter is shown in Fig. 6. It consists of a triple-pole switching unit with three double break bridge type movable silver contacts, which are operated by hand with a toggle mechanism. Two thermal overload relays trip the starter open in case of an overload. The same type of switch can also be obtained with a push button type operating mechanism.

Such starters are quite satisfactory when used with comparatively small motors. They are commercially available in sizes 0 and 1. They should only be used when they can be installed close to the motor so that the operator can observe the motor while actuating the starter. The principal advantage of manual starters is their low cost. Principal disadvantages are that such starters do not lend themselves to automatic operation, and they do not provide undervoltage protection. That is to say, if voltage reappears

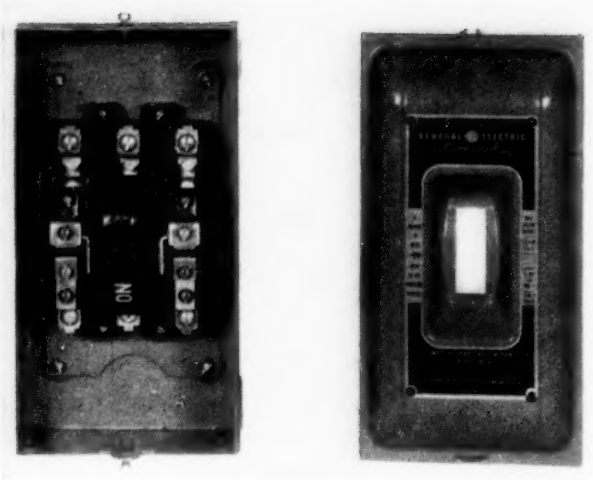


Fig. 6. Manual full-voltage starter for squirrel-cage induction motor.

after a power outage, the motor re-starts automatically without any warning to attendant personnel. Injury to the operator may result.

It must be kept in mind that manual starters do not provide short circuit protection. Under the National Electrical Code, circuit breakers may be used as motor starters if they are equipped with thermal overload trips suitable for motor overload protection, and with adequate trips for short circuit protection. Electrically operated circuit breakers may be used as motor starters, if the motors are started very infrequently. On frequently started drives, their mechanical life would not be satisfactory.

Magnetic Full-voltage Starters

Magnetic starters, as compared with manual starters, offer the advantages of greater convenience to the operator, greater flexibility, and greater safety.

Manual starters for larger motors would be hard to operate because of the great force needed to actuate the contacts. Physical location of the controller would present a problem. Locating the starter close to the motor results in the shortest runs of heavy power leads. This, however, may be a very poor location from the operator's point-of-view, and it may be difficult to operate and observe the machine. Placing the starter away from the motor would require long runs of heavy power cable. Magnetic control, on the other hand, permits installing the starter close to the motor. Actuating control devices, such as push buttons, thermostats, and the like, requiring only small size control wiring, can be located away from the motor in a position most convenient to the operator.

Shown in Fig. 7 are power and control circuits of a typical magnetic full-voltage starter. The power elements (sketch *A*) are line contactor *M* and two overload relays *OL*, one in each of two motor leads. Two alternative control circuits are indicated. In sketch *B*, line contactor *M* is actuated by a maintained contact type pilot device, for instance a small manually operated control switch. Contactor *M* is closed, hence the motor is running, whenever the pilot device is closed. In case of overload, relays *OL* open their contacts, dropping out *M* and shutting down the motor. In order to avoid immediate restarting, relays *OL* stay open after they have been tripped, and they must then be reset by hand.

This control circuit, sketch *B*, provides undervoltage release. If voltage fails, *M* drops out, and the motor stops. When voltage reappears, *M* recloses, and the motor is restarted immediately. This automatic restarting may be objectionable on drives which are controlled by operators, since an attendant may be injured by an unexpected restart. On the other hand, the pilot device may be the contact of an automatic device such as a pressure switch, a thermostat or the like, which starts and stops the motor automatically by remote control. This automatic starting and stopping of the motor can only be accomplished by magnetic, and not by manual starters, and it is well worth the extra cost of the magnetic starter. Since such automatic drives are unattended, undervoltage release presents no safety problem.

At *C* of Fig. 7 is shown a control circuit used when a momentary contact start-stop pushbutton station is employed as the pilot device. Pressing the start button energizes *M* which closes and starts the motor. An auxiliary interlock on *M* seals around the start button which can then be released, while *M* remains energized. Pressing of the stop button, or tripping of the overload relay, drops out *M*, thereby stopping the motor. In order to restart, it is necessary to press the start button again. Hence, overload relays may reset automatically after they have been tripped, since the reclosing of the *OL* contacts would not restart the motor.

Momentary-contact pushbutton control inherently obtains undervoltage protection. If voltage fails, *M* drops out and the motor stops. When voltage reappears, the motor will not restart unless the start button is first pressed. Hence, the operator is protected against a surprising and inadvertent start.

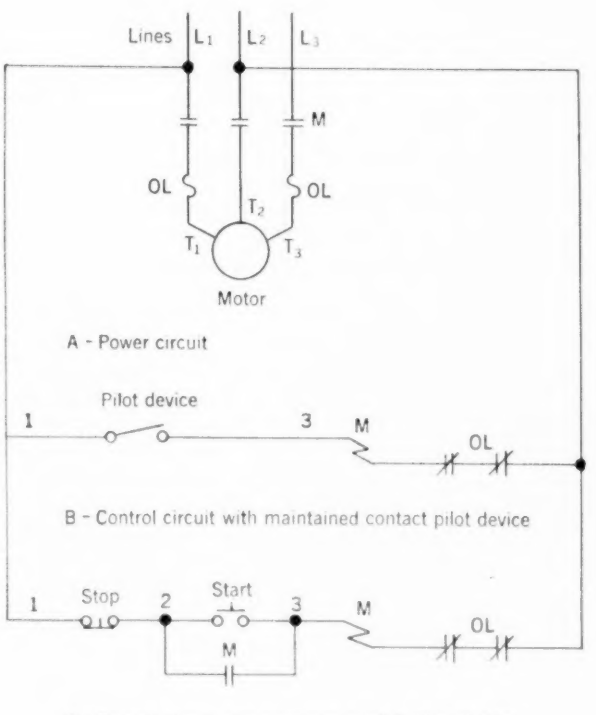


Fig. 7. Power and control circuits of magnetic full-voltage starters; M—line contactor; OL—overload relays.

Starter Construction

Figure 8 shows a NEMA size 1 magnetic starter, enclosed in a drawn-shell box, with front cover removed to show the lift-type line contactor and the overload relays. The button in the cover serves to reset the overload relays after a trip-out. Lift-type contactors were introduced to the trade some 15 years ago. Up to size 3, this design is used by practically all motor controller manufacturers; some build even larger sizes. The principal advantage of this design is its mechanical simplicity. The magnet produces a straight-line motion that is transmitted directly to the movable contacts. There are no pivots and bearings, hence, mechanical wearing surfaces are reduced to a minimum, and long mechanical life results.

The most important and fastest wearing parts are the contacts which have to carry motor running current, and which may have to interrupt locked rotor current. A certain amount of burning on account of arc interruption is anavoidable, and contacts may have to be replaced periodically. By proper contact design, and by choice of proper contact material, burning of the contacts can be reduced to a reasonable amount. Contact life of the order of hundreds of thousands of operations may be attained, whereas mechanical contactor life may be of the order of millions of operations.

An exploded view of the contact structure of a size 3 contactor is shown in Fig. 9. Contacts are of the double-break silver butt type, a movable bridge engaging with the stationary contacts of each pole. There are no blowout coils. The contacts are enclosed in a cavity within the arc chute which confines the arcs and separates the poles from each other. Arc extinction is due to cooling on the surface of the arc chute cavity. A certain amount of magnetic blowout effect is obtained by the configuration of the contacts and the current carrying paths. This blowout effect tends to stretch the arcs and to force them against the walls of the arc chute, thereby enhancing the cooling effect.

The magnet consists of laminations, stacked and riveted under pressure, and then annealed. The moving armature, carrying the movable contacts, is supported on its guide on a spherical seat. Hence, the armature is self-aligning, insuring good seating between movable and stationary parts, and resulting in quiet magnet operation. When the coil is deenergized, the magnet must drop out

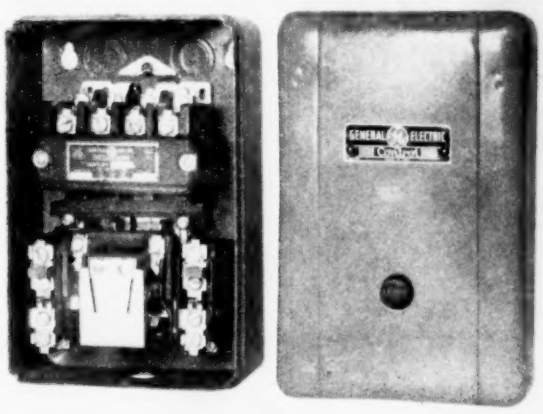


Fig. 8. Magnetic full-voltage starter for squirrel-cage induction motor.

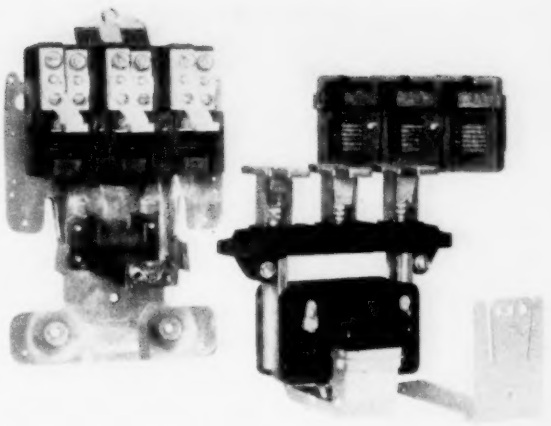


Fig. 9. Exploded view of size 3 lift-type contactor.

cleanly, without any tendency to stick on account of residual magnetism. It is accepted practice in electromagnet design to introduce an artificial air gap in the magnetic path so that the residual flux, with no current flowing in the coil, is reduced below the threshold value at which the armature begins to drop out. Two methods of obtaining such an air gap are illustrated in Fig. 10. On the left is a magnet which has a physical air gap in one of the striking surfaces. When a contactor has to operate frequently, the laminations may be flattened and mushroomed at the surfaces on which the armature strikes the stationary magnet. In service, and over a period of time, the air gap will be reduced, and eventually it will disappear completely. This disadvantage is overcome by the right-hand design. A permanent air gap in the form of a wafer of non-magnetic material has been introduced in the stationary part of the magnet. This permanent air gap is not affected by any deformation in the striking surfaces, thus resulting in increased magnet life.

Magnet coils are encased in a molded box as shown at *A* of Fig. 11. The side of the box forms the channel guide for the armature. Coils are wound of fine coated copper wire and after winding they are cast in a block of "permafil." This material is a liquid compound with a remarkable ability to penetrate the finest cracks and crevices. As permafil solidifies during the curing process, hardening takes place without any evaporation, and the coil winding is embedded in a solidly cast block, as *B* of Fig. 11. The coil winding is thus protected against mechanical injury and attack by moisture.

Standard control voltages, same as standard motor voltages, are 110, 220, 440, 550 volts. To allow for deviation of actual utilization voltage from these nominal voltages, standards established by NEMA, U/L, ASA, and AIEE prescribe that coils permit contactor closing at 85% of rated voltage, and they must not overheat unduly or cause excessive mechanical wear when 110% of rated voltage is applied. If actual utilization voltage at the point of starter installation falls outside of these tolerance limits, specially wound coils may have to be used; 208-volt network systems are generally regulated to closer limits than ordinary radial feeder systems. Hence, starters designed for operation on 220 volts are generally satisfactory when connected to a 208-volt network system.

Poorly aligned magnets, and dirt on the striking surfaces will cause the magnet to be noisy. This tends to re-

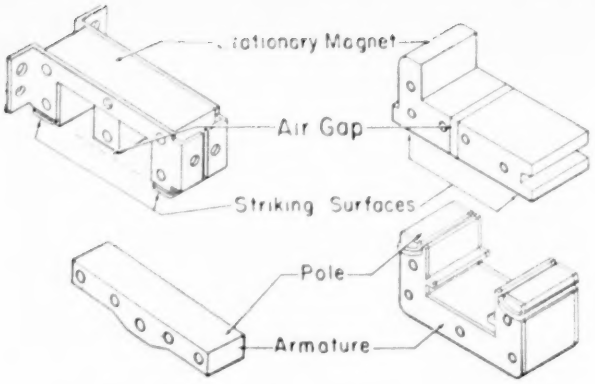


Fig. 10. Design of air gap in a-c magnet.

duce contactor life and may annoy people working in the vicinity of the starter. Even with the best of care in manufacture, a slight 60-cycle hum may be present, which may be objectionable in hospitals, research institutions, and similar locations in which very rigid specifications must be met with regard to noise level.

When such requirements must be faced, and if remote control and removal of the starter from the restricted area is not possible, it may be advisable to use a manual starter in preference to a magnetic starter. Another alternative would be to use special starters with d-c operated magnets, to be operated from a separate d-c control source. However, since such starters are built only in limited quantity, they are more expensive than standard starters.

Pilot Devices

Pilot devices are control devices, the contacts of which actuate the coil circuits of magnetic starters. They may be operated by hand, or they may be operated automatically by some process quantity, such as pressure, flow, liquid level and temperature. The contacts of pilot devices must have sufficient capacity to carry and interrupt the coil current of the starters with which they are used. In addition, they must be capable of closing in on the inrush current. When the a-c coil circuit of a starter is first energized, the coil current is limited only by coil resistance, which is very low; coil reactance is negligible because of the large air gap when the magnet is open. The initial current is called the inrush current. When the magnet is closed, the coil current is limited by the coil reactance which is then quite high. The current flowing with the magnet closed is called the magnetizing current. The ratio of inrush current to magnetizing current lies between 10 and 20 to 1, depending on magnet design.

Push buttons are the most frequently used pilot devices. They start and stop motors from a remote location. A push button unit consists of a double-break contact, connected to a plunger or button. It is actuated by pressure of a finger against the end of the button. In general, contacts are momentary, that is the button returns to its original position after finger pressure has been removed. Contacts may be normally open or normally closed. Some designs contain a double-throw unit, one contact opening and the other one closing when the button is pressed. Push button units can be purchased as individual units, to be incorporated in the design of a machine, or they may be purchased in the form of a push button station, which is an

TABLE 3—A-C CURRENT RATING OF PUSH BUTTONS

Type Duty	Make Inrush Current, Amperes	Continuous Carrying Current, Amperes	A-C Inductive Interrupting Current at Volts			
			110	220	440	550
Standard Duty	30	10	30	20	7.5	6
Heavy Duty	50	10	50	30	8	6

assembly of units in a box suitable for wall mounting. Fig. 12 is a typical unit which may be set in the cavity of a machine or in the side or door of a box. Fig. 13 is a typical standard duty, start-stop station for wall mounting.

The trade recognizes two lines of push buttons, "standard duty" and "heavy duty." This nomenclature really has nothing to do with the "duty" to which a station may be subjected. It is simply a term of long standing which differentiates between two lines of push buttons of different

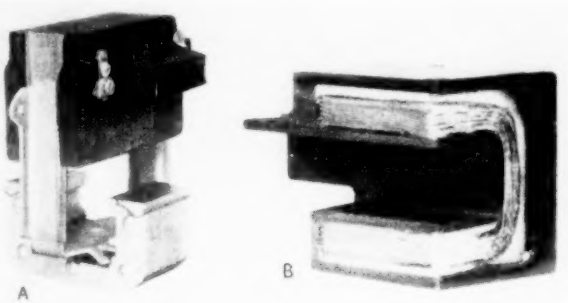
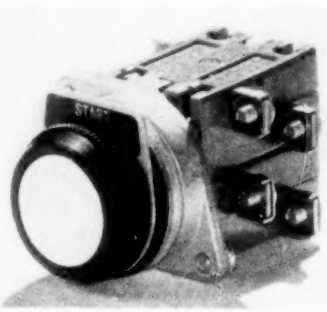


Fig. 11. Cast-in contactor coil. A—completed coil with guide for movable armature; B—section, showing how coil is cast in plastic mold.

current ratings which are defined by a testing procedure set up by Underwriters' Laboratories Inc. A-c ratings for the two lines are listed in Table 3.

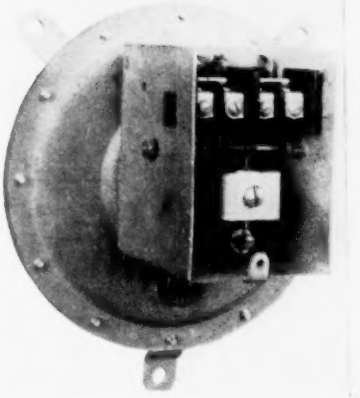
Numerous pilot devices are on the market for automatic starting and stopping of motors by some operating quantity. Such pilot devices consist essentially of a contact unit and some actuator which in turn is moved mechanically by heat, pressure, liquid level, and the like. Fig. 14, an example, is a pressure switch. The actuating mechanism is a diaphragm, housed in a chamber, which is piped to the system. The diaphragm is connected to a push rod which, in turn, actuates the contact mechanism. Since there must be a difference in pressure to cause the dia-

Fig. 12. Oil-tight push button unit.



phragm to move, there is a certain differential between actuating and resetting of contacts. This differential depends on the mechanical design of the pressure switch, and it is generally listed in the available manufacturer's catalog.

Fig. 14. Pressure switch.



Reduced-voltage Starting

Full-voltage starting of squirrel-cage motors may be objectionable for two reasons. First, it may be desirable, for technological reasons, to reduce the starting torque in order to reduce any shock or sudden strain on material in process. This reason appears frequently on processing machinery, for instance in the textile field. It has generally no significance in conjunction with fan, compressor, pump, or similar drives.

Of greater importance are power company regulations which may limit the permissible motor starting current inrush in order to limit momentary voltage dips which may result in lamp flicker or other system disturbances. In metropolitan areas or on stiff industrial power systems, which are well interconnected and not far removed from points of generation, full-voltage starting can be permitted for motors up to 100 hp, and even larger. However, in outlying districts, or near the ends of long radial feeders, it may be necessary for the power company to specify that steps be taken to reduce the motor starting inrush current.

In the case of wound rotor motors, any desired amount of starting current can be realized by connecting an appropriate amount of resistance in the rotor circuit. Squirrel-cage motors, however, do not have connections brought out from the rotor. Starting performance of a squirrel-cage motor on a commercial power system can only be influenced by affecting the impedance of the motor primary circuit. One method is to change the effective impedance of the motor windings by reconnecting them. The other method is to insert extraneous impedance between the power line and the motor. This impedance absorbs a portion of the available line voltage so that only partial or reduced line voltage appears across the motor terminals. Since both methods have an equivalent effect on motor starting performance, they are popularly known as "reduced-voltage starting." With reduced-voltage starters, the motor is first connected to the power line in the starting connection, and, after a time delay, the motor is connected across the line.

Fig. 13. Standard-duty push button station.

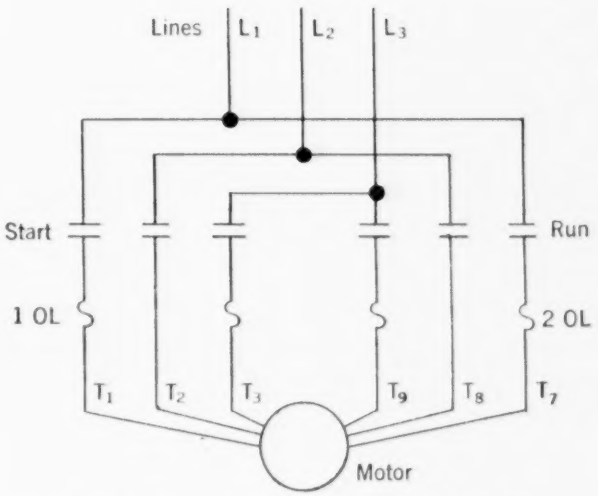


Fig. 15. Power circuits of a part-winding starter.

Part-winding Starting

Certain of the smaller sizes of general purpose squirrel-cage motors are built with reconnectable windings so that the motor may be connected to either a 220-volt or a 440-volt line. Each stator phase consists of two winding sections which are connected in parallel when the motor is used on a 220-volt system, and in series when the motor is connected to a 440-volt system. Either 9 or 12 leads are brought out to the motor terminal board, depending on whether the motor has been designed with a wye or delta-connected winding.

When reconnectable motors with wye-connected primary winding are used on a 220-volt system, a simple part-winding starter may be employed with power circuits as indicated in Fig. 15. Each half of the stator winding is treated like a separate motor, there are two line contactors and two sets of overload relays. When the "start" button is pressed, the start-contactor closes and connects one half of the motor winding to the line. With this connection, the starting inrush current is approximately 70% of the inrush current which would flow if the motor were started with the full winding in the circuit, which means it is of the order of four times full-load current. After a time interval, which may be governed by a time-delay interlock or a time-delay relay, the run-contactor closes. Both parts of the winding are then connected to the line and normal motor performance results.

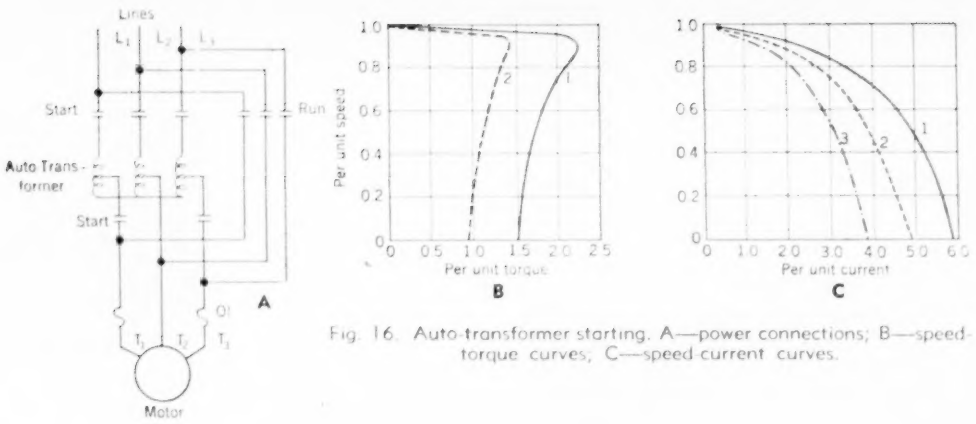


Fig. 16. Auto-transformer starting. A—power connections; B—speed-torque curves; C—speed-current curves.

Part-winding starting is comparatively inexpensive and hence popular in metropolitan areas where reconnectable motors can be used on a 220 or 208-volt system. It is seldom used on 440-volt industrial systems since it would require special design of the split primary winding with extra leads brought out to the terminal board. The resultant extra cost of the motor would be prohibitive, except for motors of rather large size.

Wye-delta Starting

Another starting method utilizing reconnection of the motor winding is wye-delta starting. Both ends of each phase of the primary winding are brought out. On the starting step the windings are connected in wye, and on the running step they are connected in delta. The initial starting inrush is thereby reduced by a ratio of $1/\sqrt{3}$, making the inrush current roughly 3.5 times full-load current.

While wye-delta starting has become very popular in Europe and other foreign countries, it has not gained a foothold in the United States since it would require that standard motors must be delta-connected, and six leads must be brought out. This imposes a restriction on motor design which has not been adopted in this country.

Auto-transformer Starting

The most popular form of reduced-voltage starter is the auto-transformer starter, popularly known also under the name "starting compensator." An auto-transformer, connected between the motor and the line, impresses on the motor terminals a fixed portion of the line voltage during the starting period. Power connections are indicated in Fig. 16A. The start-switch connects the motor to the line through an auto-transformer. After a time delay, sufficient to allow the motor to start and accelerate, the start-switch is opened and the run-switch is closed, connecting the motor to full line voltage. It is important that the start and run switches underlap. If the run-switch were to close before the start-switch has opened, heavy current would be induced in the short circuited transformer coils, which might cause mechanical damage to the transformer windings. Also, it is necessary that the start-switch be equipped with five poles to avoid short circuiting the auto-transformer windings, with consequent heavy circulating current while the motor operates on full voltage.

Starters of different manufacturers differ in certain design details. Some starters use a two-legged auto-transformer with the two legs connected in open delta. Others use a three-legged auto-transformer with the three legs connected in wye. There is no basic economic advantage in either transformer design since both require the same amount of active iron and copper. However, the use of a three-legged transformer results in more balanced currents in the motor primary winding during starting. The manner in which the closed-loop circuit through the transformer windings is broken in the run-connection may also differ somewhat. All conventional starter designs, however, employ a five-pole start-switch.

Reducing the voltage applied to the motor reduces both the load current and the magnetizing current or flux in proportion to the applied voltage. Since torque is proportional to the product of load current and flux, torque is reduced as the square of the applied voltage. In Fig. 16B, curve 1 is the speed-torque curve of a squirrel-cage motor in the run-position of the starter (which is the same as curve 1 in Fig. 1A). Curve 2 is obtained in the start-position with 80% of rated line voltage applied to the motor. Curve 2 is a replica of curve 1, except that for each speed point, the torque is reduced to 64% of the torque of curve 1. Speed-current curves are plotted in Fig. 16C. Curve 1 is the motor current in the run-position (which is the same as curve 1 in Fig. 1B). Curve 2 is the motor current flowing in the start-position with 80% voltage applied to the motor. The line current, curve 3, is again reduced by the turn ratio of the auto-transformer. Hence, at each speed point the current of curve 3 is 80% of the current of curve 2, or 64% of the current of curve 1.

Fig. 17. Manual auto-transformer starter.

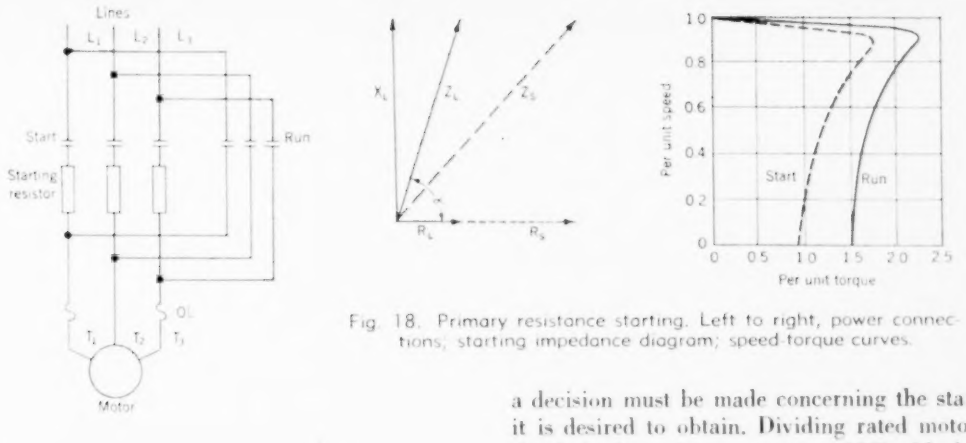


Fig. 18. Primary resistance starting. Left to right, power connections; starting impedance diagram; speed-torque curves.

Auto-transformer starting offers a most effective means of reducing the starting inrush current, which, when seen from the power line, is reduced as the square of the turn ratio of the transformer, and this method of starting obtains the greatest torque per ampere drawn from the line. Standard auto-transformers have taps brought out to give a choice of 50, 65 or 80% of line voltage so that at the installation, the proper tap can be chosen which best suits the specific application requirements.

Manual or magnetic auto-transformer starters are available. Shown in Fig. 17 is a manual starter. The handle is so interlocked by a mechanical latch that the start-switch must be closed first, and then the run-switch. An undervoltage solenoid holds the run-switch closed. It drops out when the stop button is pressed, the overload relay trips, or voltage is lost. Thus, undervoltage protection is obtained, and after each shutdown the motor must be restarted in proper sequence. Magnetic starters employ contactors in place of the manually operated switches, and a timing relay provides for automatic transfer from start to run. Auto-transformer starters have a comparatively high cost, and for that reason starters are also used which insert resistance in series with the motor during starting.

Primary Resistance Starting

Starting current and torque can be reduced by inserting an extraneous resistor in series with the motor windings. The total impedance of the motor circuit, which the power system sees, is thereby increased. Power connections of a primary resistance starter are indicated in Fig. 18A. Manual starters contain a manually operated start- and run-switch. Magnetic starters have a start and a run-contactor. The start-switch or contactor connects the motor to the line with the starting resistance in series. After a time delay, the run-switch or contactor closes, short circuits the starting resistor, and thus applies full voltage to the motor winding.

In order to determine the required starting resistance, it is necessary to obtain from the motor designer the locked rotor current and the locked rotor power factor. Dividing rated motor voltage by the locked rotor current obtains locked rotor impedance Z_L. Knowing the locked rotor power factor $\cos\alpha$, this impedance can be split into reactance $X_L = Z_L \cos\alpha$ and resistance $R_L = Z_L \sin\alpha$, as shown in the impedance diagram Fig. 18B.

To establish a basis for designing the starting resistor, a decision must be made concerning the starting current it is desired to obtain. Dividing rated motor voltage by the desired starting current, say 80% of locked rotor current, obtains the required starting impedance Z_S. See Fig. 18B. In order to realize that required impedance, the total primary resistance must be $R_S = \sqrt{Z_S^2 - X_L^2}$. The resistance of the external starting resistor, supplied with the starter, is then $R_S - R_L$.

Terminal voltage across the motor at standstill bears the same relationship to line voltage as starting current bears to locked rotor current. Hence, with the starting current reduced to 80%, a voltage of 80% appears across the motor at standstill, and the starting torque is 64% of the normal starting torque. In Fig. 18C, the solid curve is the speed-torque curve of the motor in the run-connection (which is the same as curve 1 in Fig. 1A), whereas the broken curve represents performance in the start-connection, that is to say, with primary resistance in series. As the motor accelerates, its impedance decreases and its power factor increases. Since the drop across the starting resistor is in phase with the current, the voltage appearing across the motor terminals rises only slightly over the voltage at starting, and the maximum torque in the start-connection is considerably lower than the maximum torque obtained with full-voltage starting.

As compared with an auto-transformer starter, a primary-resistance starter has the advantage of lower cost since the starting resistor and three-pole start-switch (contactor) are less expensive than an auto-transformer and five-pole start-switch (contactor). On the other hand, starting current drawn from the line is the same as motor current, hence line current reduction is not so great as that obtained with an auto-transformer starter.

Wound Rotor Motor Starters

Wound rotor motors are used on heating, ventilating and similar equipment to a limited degree for such jobs where speed adjustment in steps is needed, generally for changing the volume of the delivered medium. The required range of speed adjustment is limited. It seldom exceeds 25 to 30% speed reduction, and it rarely attains 50%. The secondary resistance required for attaining a desired speed reduction for fan and friction loads can be read from Fig. 5, and speed-torque curves for various amounts of secondary resistance are given in Fig. 2. Since in most cases the resistance needed for speed control does not reduce starting torque and current to a sufficiently low value, an additional resistor section is generally required which is used during starting only. That portion of the

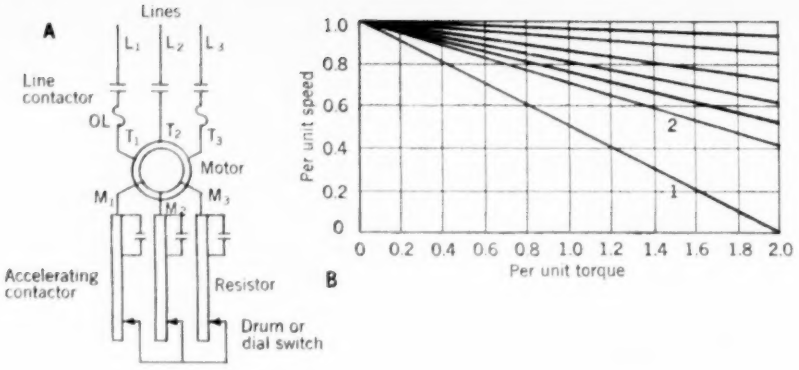


Fig. 19. Wound rotor motor starting. A—power connections; B—speed-torque curves.

resistor which is used for speed regulation must have sufficient capacity to carry current continuously. The starting section needs to have current carrying capacity only for a short time.

Formerly, manual starters of the drum switch type were used to some extent. Drum switch contacts were used for connecting the motor primary to the line, and for switching the secondary resistor sections. Such manual starters had two fundamental disadvantages. Undervoltage and overload protection could be obtained only with the help of extraneous equipment. Since starting and speed regulating resistor sections were switched by the same manual switch, there was danger that the operator might run the motor inadvertently on the starting section for too long a period of time, resulting in damage to the resistor.

In spite of their low price, manual starters have, to a large extent, disappeared from the market. Semi-magnetic control, the principles of which are illustrated in Fig. 19, is a technically sound and economical solution in cases where speed adjustment is needed at infrequent intervals. Fig. 19A shows the power connections in a schematic manner. A standard magnetic switch, consisting of line contactor and overload relay, is used to connect the motor to the line. Hence, overload and undervoltage protection is obtained in the same manner as with a squirrel cage motor starter. One or two secondary accelerating contactors close automatically, under the control of suitable timing relays, and short circuit the starting sections of the secondary resistor. A drum or dial switch, which closes the wye-point, serves to adjust the speed by shifting the wye-point along the regulating section of the resistor. The manual switch is equipped with an auxiliary interlocking switch which is closed in the all-resistance-in position of the switch, so wired that the line contactor can be closed only with all resistance in the secondary circuit.

Typical speed-torque curves are plotted in Fig. 19B. Curve 1 represents performance with the starting resistance in the circuit, obtaining a starting torque, and correspondingly a starting current, of twice normal. Curve 2 represents performance after the accelerating contactor has closed, with all regulating resistance in the circuit. Speed reduction at normal motor torque (representing a friction load) would be 30%. The un-numbered curves represent performance on the speed regulating points of the drum or dial switch.

In Fig. 20 a typical drum switch is shown, representative of a design suitable for use with motors up to 100 hp. The resistor may be built on the switch, or it may be mounted separately. Fig. 21 is a dial switch, representative of a design suitable for motors up to 10 hp. In general, the resistor is mounted behind the dial plate.

Overload Protection

An overload on a motor is the flow of higher than normal current through its stator. It may be caused by excessive mechanical load on the motor up to the stall point, by line voltage being below the rated value, or by single-phasing, that is, loss of one of the primary phases. The increased current flow causes overheating of the motor winding, which may damage the motor by failure of the insulation or by open-circuiting internal connections in the motor. Any overheated motor represents a fire hazard, hence the National Electrical Code prescribes that each motor branch-circuit (the circuit between the power distribution switchboard and the motor) includes motor overload protection.

Two overload relays, one in each of two phases, are required by the Code for protection of three-phase or two-phase motors. If the overload is caused by excessive mechanical load or by low line voltage, overcurrent flows in all primary phases. If the overload is caused by single-phasing, excessive current flows in two lines to the motor. Hence, at least one of the two overload relays carries the overcurrent. There are some special cases when wye-delta or delta-wye connected transformers feed the motor circuits on a three-phase system, and where loss of one

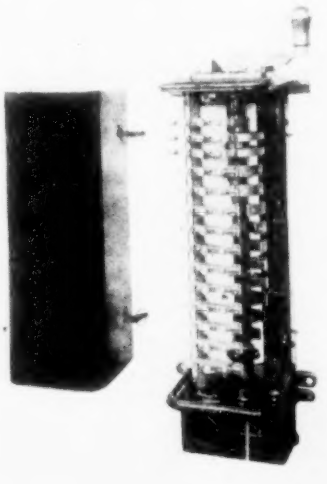


Fig. 20. Drum switch manual controllers for wound rotor motor secondary control.

primary transformer phase is likely to occur. In such a case only one motor phase may carry excessive current and three overload relays, one in each line, may have to be used. Such a requirement is not likely to come up in a metropolitan area, but it may come up on a rural pumping job where power to the motor load may be brought over a vulnerable pole line.

Good protection allows the motor to carry any load, including an overload, just long enough so it will not overheat; but the motor should be disconnected as soon as it reaches its ultimate safe temperature. Small motors, especially fractional horsepower motors, which are built in large quantities for specific purposes, are equipped with inherent overheating protective devices which are imbedded in the motor windings and respond directly to the heat generated within the motor. Such devices can not be used economically on larger general purpose motors since it would be too expensive to develop inherent protective devices for all possible applications. Among starter manufacturers, as well as users, thermal overload relays are universally accepted as the most desirable type.

Thermal overload relays are "replica" relays. They "see" the current flowing in the motor, and the heat generated within the relay, which eventually causes the relay to trip, follows substantially the heating characteristic of the motor. In laying out a tripping characteristic for a relay, the tripping time at slight overloads must be long enough to enable the motor to carry that overload for a safe period of time. When the motor stalls, however, it must be disconnected quickly, because at standstill the motor heats up much more rapidly than if it were running, with the same current flowing. Unfortunately, motor heating characteristics are not standardized, and overload relay design must, of necessity, be a compromise. Underwriters' Laboratories, Inc. have established in their Standard for Industrial Control Equipment, the tripping time for certain values of motor current. A complete relay tripping characteristic, based on these limiting values, is given in Fig. 22. Experience has shown that about 95% of all motors used on industrial applications are adequately protected by relays which follow or fall below the indicated trip curve.

Two types of thermal relays have found widespread practical applications, namely bi-metallic and solder-film relays. A bi-metallic relay, of the type as used on the starter in Fig. 8, is shown in Fig. 23. Motor current flows through a nichrome heater, which deflects a bi-metal strip, which in turn actuates the relay contact mechanism, using a toggle to obtain snap-action tripping of the contact. After

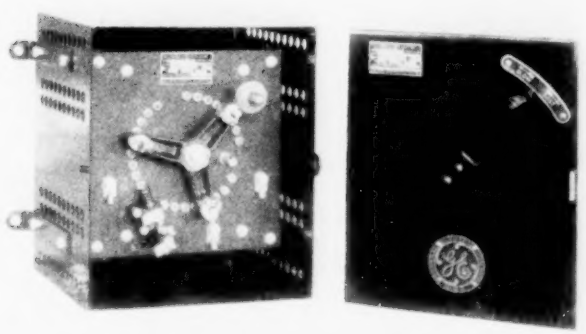


Fig. 21. Dial switch for manual controller.

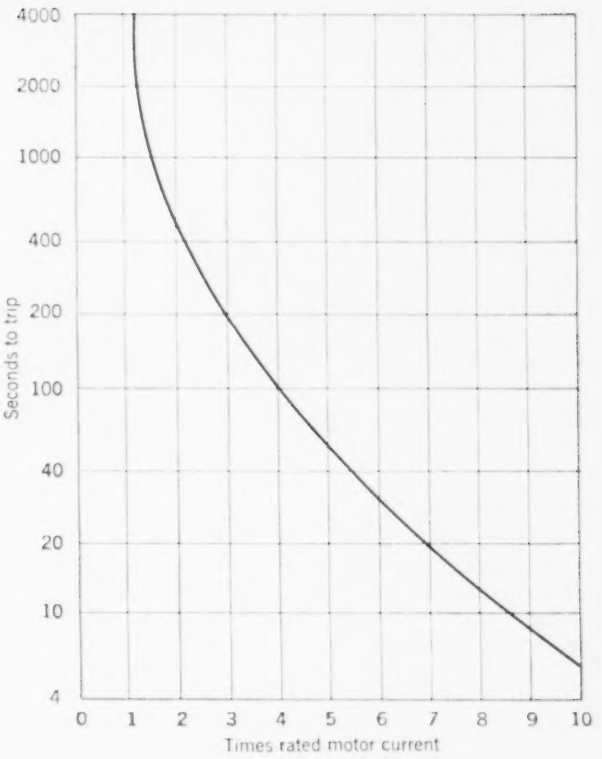


Fig. 22. Limiting overload relay tripping characteristic in accordance with U/L standard.

the relay has tripped, the contact stays open. The contact is reclosed manually by pressing the reset knob, thereby readying the motor for a new start. Of course, the operator should investigate and remedy the cause of the overload before resetting the relay.

Solder film relays function in a similar manner. The heater softens a solder film which, when melting, releases a spring-loaded trip mechanism opening the relay contact.

Cost would be prohibitive if starter manufacturers would build a special relay for each value of motor current. Instead, a standard relay is used which covers a wide range of motor ratings, and a line of relay heaters is available to fit the relay to specific motor applications. In each starter, and in the manufacturers' catalogs, there are tables stating the range of motor currents for which each heater gives adequate protection. General purpose open a-c motors are rated on the basis of attaining a temperature rise of 40C at rated load. They are capable of carrying 115% of rated load without injurious heating. Such motors are said to have a "service factor" of 1.15. The curve in Fig. 22 indicates that the relay will ultimately trip at 115% current. Since economics limits the number of heaters that can be used with a given relay, and since allowance must be made to variations in relays due to manufacturing tolerances, the Code allows heater selection on the basis of 125% motor current for 40C rise rated motors. When motors are employed which are rated for a temperature rise of 50C at rated load, there is no service factor, and heaters are selected on the basis of 100% motor current.

Short-circuit Protection

The National Electrical Code requires that every motor branch circuit is protected against the devastating effects

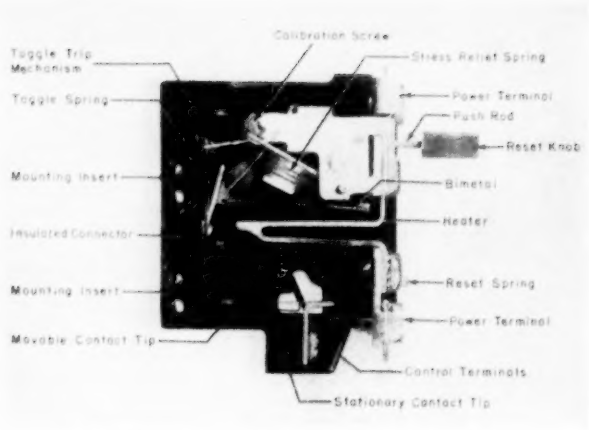


Fig. 23. Bi-metallic thermal overload relay.

of short circuits. Under U/L standards, a-c motor starters are designed to interrupt six times their rated motor current. They are not capable of interrupting the high currents which may flow under fault conditions. Other devices must be utilized to provide suitable short circuit protection.

Short circuit currents which may flow in a branch circuit do not depend on motor size but on the characteristics of the power system to which the motor is connected. The worst location of a fault would be at the load terminals of the starter. The magnitude of the short-circuit current which may flow depends on the total impedance in the circuit from the source of power to the point of fault. This total impedance includes the impedance of the motor starter and the impedance of the fault. That impedance is difficult to evaluate, and it varies from case to case. It is affected by the size of the starter, and particularly the overload relay heaters.

In order to rate and apply motor starters on a uniform basis, it is customary to calculate an "available short circuit current" which would flow if the line terminals of the controller were short circuited. The maximum short circuit current which would actually flow through the starter would then be somewhat smaller than the calculated available short circuit current. Faults are not likely to occur within a starter, thus starters with high interrupting capacity are designed to interrupt faults at or beyond the starter load terminals.

Most industrial power users are connected to a fairly large and interconnected power system. On such a system the impedance between the power source and the high voltage side of the transformer feeding the motor branch-circuit is small, and the voltage drop to the transformer may be neglected. It is reasonable to assume that the system voltage on the high side of the transformer remains at its normal level during a fault. The magnitude of the short circuit current is thus determined by the impedance of the step-down transformer and the motor feeder. If a starter is installed close to a transformer bank, a total fault impedance of 5% is not uncommon, which means, if no other motors were running which would otherwise contribute current to the fault, the short circuit current would be 20 times the rated current of the transformer.

As an example, the available short circuit current would be 12,000 amperes on the 480-volt side of a 500 kva transformer bank, or on the 240-volt side of a 250 kva transformer bank. Because of the contribution to the fault current by induction and synchronous motors which may be running when the fault occurs, the short circuit current may actually be approximately 10% higher.

Short circuit currents, as calculated by this method, are symmetrical rms* (root mean square) currents, or the steady-state currents which would ultimately flow at the point of starter installation. A symmetrical short circuit current as shown at *A* of Fig. 25 would flow if the fault would occur at the instant when the feeder voltage wave is at its peak. If the fault occurs at any other instant, the short circuit current includes a transient d-c component which is maximum if the fault occurs when the feeder voltage wave passes through zero. Such an asymmetrical short-circuit current is illustrated at *B* of Fig. 24. The d-c component decreases to zero within a few cycles. However, the design of apparatus suitable for interrupting short circuits must take into account the mechanical and thermal stresses caused by the initial offset current wave.

To provide full protection of the power system against short circuits, to protect the motor branch circuit conductors, and to protect the starter itself against destruction, it is necessary to back up the starter by devices which are capable of interrupting short circuit currents with safety. Two kinds of devices are recognized by the National Electrical Code, namely time-limit circuit breakers and fuses.

Under existing standards it is customary to rate low-voltage power interrupting devices in terms of actually interrupted rms current. To establish a uniform basis for interrupting ratings, it is assumed that the d-c component of the short circuit current may add 25% to the calculated symmetrical rms current. As an example, if calculation obtains a symmetrical available short circuit current of 12,000 amperes, a circuit breaker should be used having an interrupting rating of 15,000 amperes.

Concerning the number of overcurrent trip elements or

* The rms value of current is the effective value of an alternating current wave. It is the square root of the average of the squares of the current taken throughout one period. Commercial alternating currents are assumed to be sinusoidal and the rms current is the maximum current of each half cycle divided by the square root of two. The rms value of current is the current measured by an ordinary switchboard ammeter. That value of current determines the heating caused by an a-c current in a conductor or the mechanical work done by a motor.

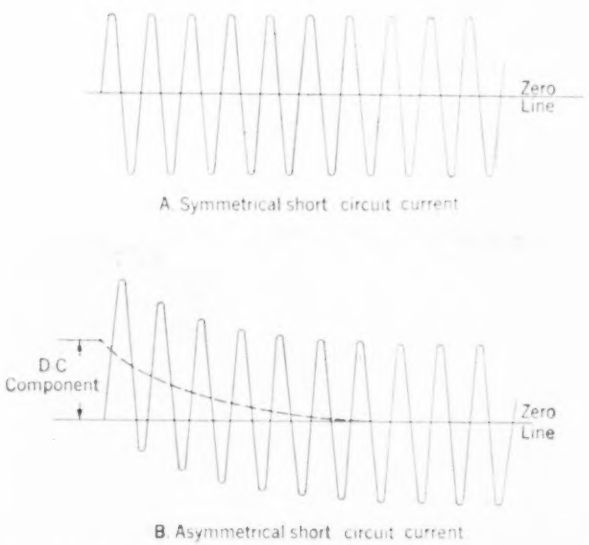


Fig. 24 Symmetrical and asymmetrical short circuit current.

fuses, the Code requires that protection be provided in each ungrounded conductor. Hence, triple-pole starters for three-phase or for two-phase three-wire circuits must be protected by circuit breakers with three overcurrent trips, or by three fuses.

Combination Starters

Although the Code leaves it to the user whether to include short circuit protection in the starter, or to use separate devices, combination starters are growing in popularity. Combination starters contain, in a common enclosure, a conventional starter and circuit breaker, or a fused motor circuit switch. Shown in Figs. 25 and 26 are the two types of combination starters which are offered by most control manufacturers.

The most popular type of breakers used on low-voltage circuits of medium interrupting capacity are the so-called "molded-case" breakers which are completely housed in a molded compound case. They are manually operated. They have combination thermal and instantaneous trips. At low overcurrents, up to approximately 10 times rated breaker current, they have an inverse-time trip characteristic. Above 10 times current, the instantaneous trips take over and open the breaker within approximately one cycle. Breakers are available with current ratings between 15 and 600 amperes. They have an interrupting rating of 15,000 amperes. This means, they can be used on circuits having an available short circuit current calculated at 12,000 amperes rms symmetrical. Shown in Fig. 25 is a combination full-voltage starter with molded-case circuit breaker which is actuated by a handle on the outside of the case. Breaker and case door are mechanically interlocked so that the door can only be opened when the breaker is opened and power is removed from the starter.

Molded-case circuit breakers, for use in combination starters, are built in 100-ampere, 225-ampere, and 600-ampere frame sizes. In each frame size a number of trip ratings are available, the smallest one being 15 amperes. Under the Code rules, the trip current ratings are so selected that they do not exceed:

250% for squirrel-cage motors used with full-voltage starters.

200% for squirrel-cage motors used with reduced-voltage starters.

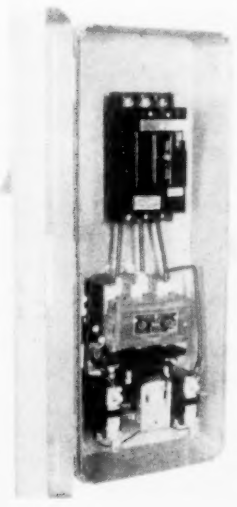
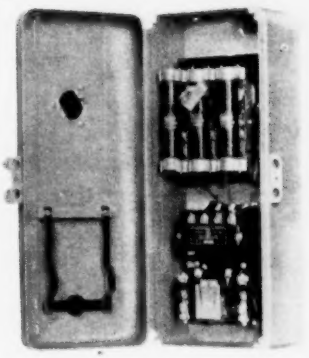


Fig. 25. Combination starters with molded-case circuit breaker.

Fig. 26. Combination starter with fused motor-circuit switch.



150% for wound rotor motors.

Experience has shown that these trip ratings are low enough to provide good protection of the branch circuit conductors and high enough so that the breaker will not trip on starting inrush current.

Fig. 26 shows a combination full-voltage starter with a fused switch as disconnecting and short circuit protecting

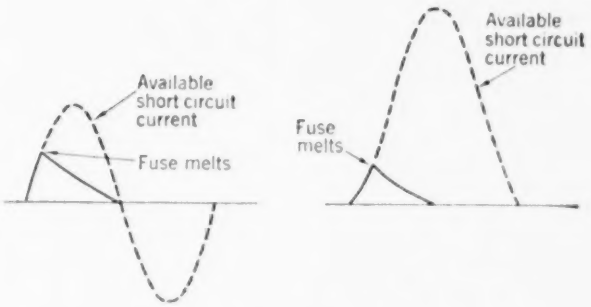


Fig. 27. Current-limiting action

means. The switch is a motor circuit switch, that is, a switch which is rated in horsepower, and which is capable of interrupting locked rotor motor current. Under high short circuit currents, fuses of the smaller sizes are "current limiting." This behavior is illustrated in Fig. 27 for symmetrical and asymmetrical short-circuit currents. The fuse melts during the initial current rise. Then an arcing period follows during which the current drops to zero, and the current is interrupted before it reaches its initial peak during the first half-cycle.

Conventional NEC cartridge fuses are tested by Underwriters' Laboratories, Inc. with direct current of 10,000 amperes. Considerable variations exist in the a-c interrupting ability of fuses of different current ratings and of different manufacture. Various makes and sizes of ordinary fuses have been used successfully in combination starters on power systems with available short circuit currents up to 20,000 amperes symmetrical, or 25,000 amperes asymmetrical.

Recently, fuses have been placed on the market which are designed and tested to obtain a definite interrupting rating. In outward appearance they do not differ greatly from ordinary fuses, and they fit standard fuse clips. On the other hand, special rejection type fuse clips are available which permit only the use of the special fuses but not of the ordinary fuses. Such clips can be mounted on the starter in cases where it is desired to prevent substitu-

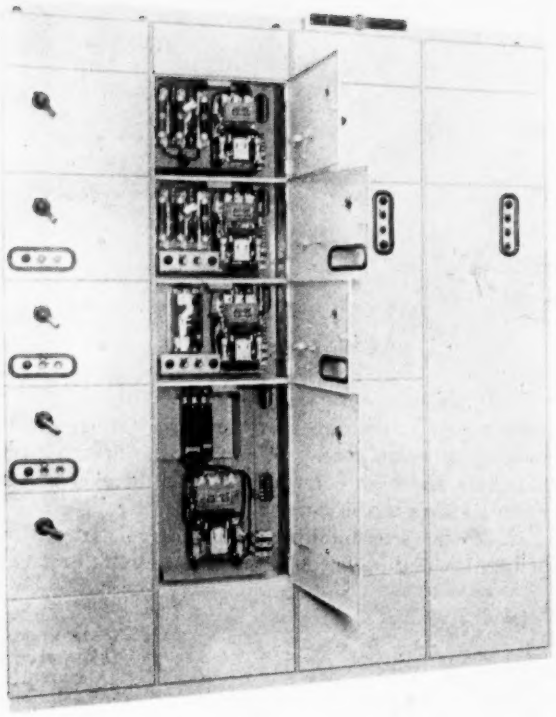


Fig. 28. Motor control center.

tion of ordinary fuses. Several makes of high-interrupting capacity fuses are now on the market with published a-c interrupting ratings, and with well defined current-limiting characteristics.

Under the Code rules, fuses are so selected that their current ratings do not exceed:

300% for squirrel-cage motors used with full-voltage starters,

250% for squirrel-cage motors used with reduced-voltage starters,

150% for wound rotor motors.

Both circuit breakers and fuses are recognized by the Code as adequate protective means. Some users prefer breakers on general principles because they open all lines to the motor whereas a partial fault may cause only one or two fuses to blow. Breaker trip units cannot be tampered with easily, and the degree of protection cannot be altered after installation of the equipment, whereas the originally supplied fuses could be replaced by larger ones, or even by pieces of copper wire. On the other hand, the current limiting action of fuses reduces the thermal stresses in the starter due to short-circuit currents. The most vulnerable part of a starter are the overload relay heaters which, for smaller motors, consist of Nichrome wire. These heaters may melt and vaporize, thus potentially causing short circuits within the starter, unless the fault current is interrupted quickly. Fuses can be obtained in current ratings of less than 15 amperes, and they provide better protection for small motors, say 3 hp and less. For these reasons, many users prefer fused starters for small motors.

When a number of motors are installed in a plant or in a building within a somewhat limited area, it is advantageous to combine the motor starters in a coordinated structure, a so-called motor control center. A typical design is shown in Fig. 28. Such a structure consists of a number of vertical sections, each section having several compartments which contain combination starters, either with molded-case circuit breaker, or with fusible motor circuit switch. Vertical bus risers connect the starters to the horizontal busses in the top of the structure. Control wiring may or may not be brought to terminal boards, depending on the user's wishes. Thus, the user receives on the site a complete, coordinated, and especially engineered equipment which saves on installation cost, since all starters have been mounted and bussed in the factory.

Under NEMA standards, three types of construction are recognized as follows:

Type *A* contains no terminal boards for either load or control connections.

Type *B* contains terminal boards for load and control connections at each starter. This appears to be the most popular type.

Type *C* includes interconnecting wiring between starters, when required. Load and control terminals are provided on a terminal board for each vertical section.

Standard control centers, containing molded-case breakers for each motor branch circuit, can be connected to a power system having a maximum available rms short circuit current of 15,000 amperes asymmetrical. Considering average transformer impedance and some pump-back current from motors which are running when the short circuit occurs, the maximum transformer capacity to which such a control center may be connected amounts to 500 kva at 600 volts, 400 kva at 480 volts, and 200 kva at 240 volts.

Conclusion

Squirrel-cage induction motors with *full-voltage magnetic starters* are most widely used in industry, for either manual or automatic operation. Other types of starters, as offered by control manufacturers, are suited to fill the following needs:

For small motors, where price is important, where automatic operation is not needed, where undervoltage protection is not important, or where quiet operation is demanded, *manual starters* may be used.

Where power company rules demand reduction of starting inrush current, reduced-voltage starters must be used. *Part-winding starters* may be employed with 440/220 volt reconnectable motors when used on 220 or 208 volt lines. *Auto-transformer starters,* while the most expensive type, obtain most effective reduction of inrush current drawn from the line. *Primary resistance starters* are less expensive and obtain a lesser degree of reduction of inrush current.

When periodic speed adjustment is needed, wound rotor motors are used with *semi-magnetic starters* including contactors for starting and manual drum or dial switches for speed control.

Combination starters, with molded-case circuit breakers or fused motor-circuit switch, provide short-circuit protection in addition to overload protection.

Control centers are integrated structures containing a multiplicity of combination starters. They reduce installation expense when a multiplicity of motors are installed in limited area.

Suction Gas Superheaters for Freon-12 Systems

Charts were developed by engineers of York Corp., York, Pa., to simplify the solution of problems where the engineer wants to find the length of double pipe superheater required for special installations.

SUPERHEATERS for use with thermal valve-fed evaporators can be obtained as double pipe and shell and coil types. They are used in thermal valve-fed refrigeration systems to insure that dry refrigerant gas is delivered to the compressor. Superheaters provide the necessary suction gas superheat to operate thermal expansion valves, if only a portion of the circulating refrigerant is passed through the heat exchanger. A number of charts were developed, with Freon-12 as the refrigerant, to simplify the determination of the length of double pipe superheater required for a special installation.

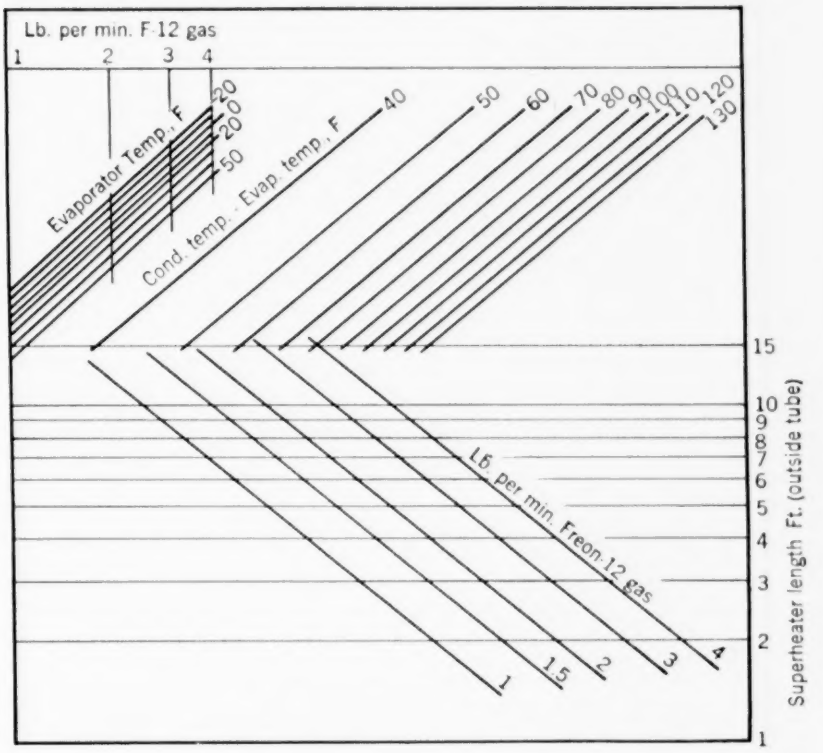


Fig. 1. Superheater ratings for 5/8-inch x 7/8-inch double pipe superheater.

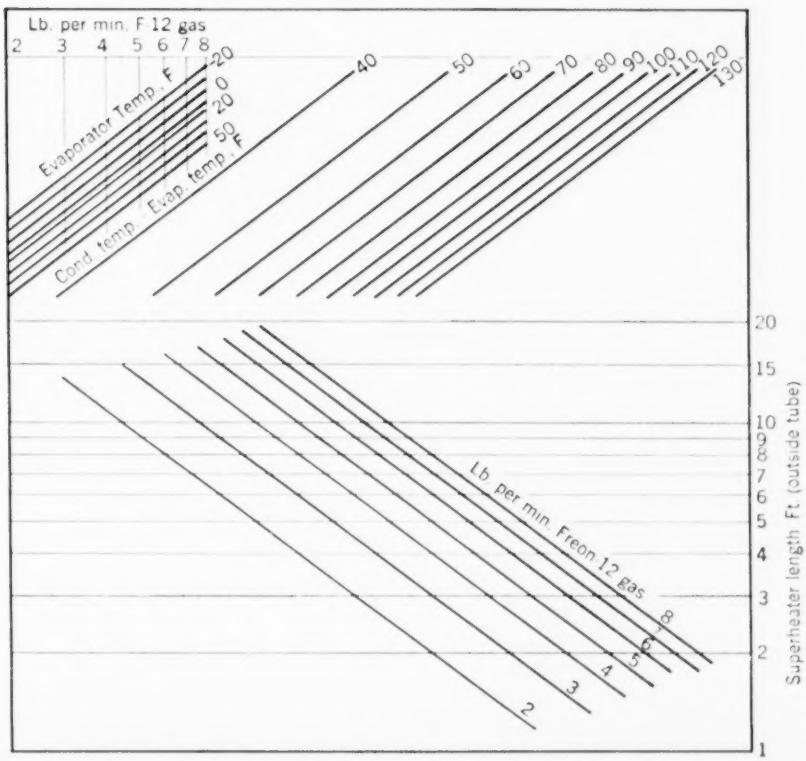
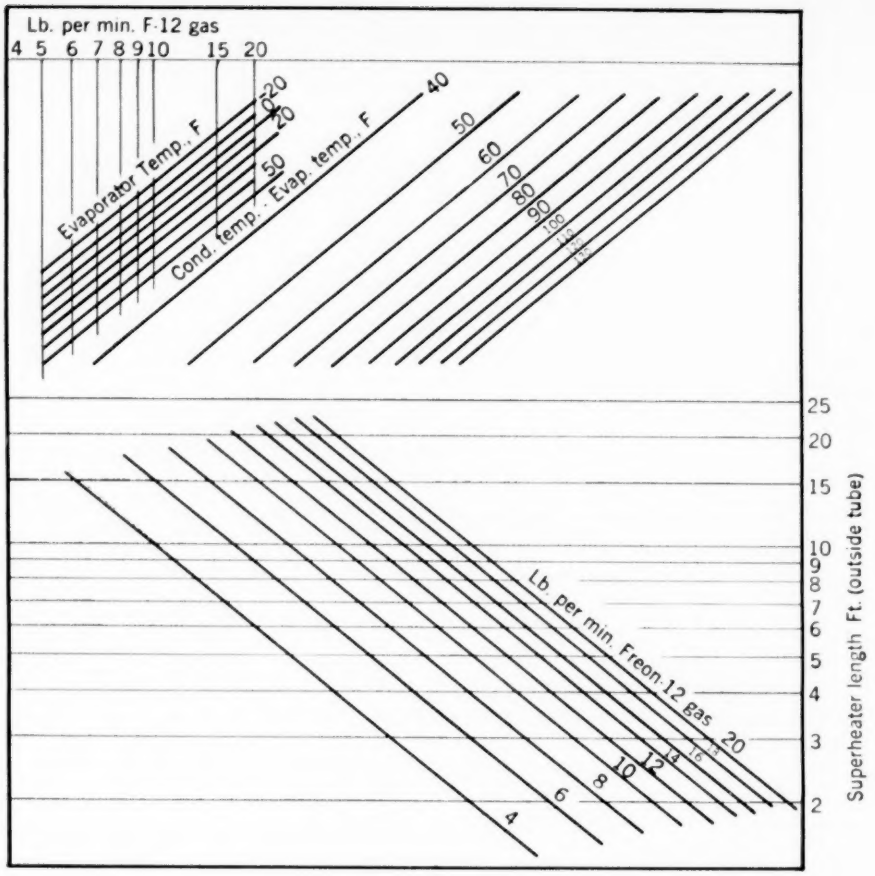


Fig. 2. Superheater ratings for 7/8-inch x 1 1/8-inch double pipe superheater.

Four of these charts (Fig. 1 to 4) are in this article and one was presented as part of the introductory article on page 82, March, 1953, HEATING AND VENTILATING. In that issue were also piping hookups to show how the double pipe superheater is connected to permit 20% of the refrigerant to flow through the superheater. These sizing charts are based on 20% of the total refrigerant flow passing through the superheater and they are predicated on: Size of suction line which forms the inner pipe of the superheater; pounds per minute of Freon-12 gas that passes through the suction line; difference between condenser and evaporator temperatures; and sufficient heat transfer surface to superheat suction gas 10F with an additional 60%

Fig. 3. Superheater ratings for 1⅛-inch x 1⅜-inch double pipe superheater.



surface to evaporate liquid slop-over.

Here is an illustration of how a chart is used.

Problem: Let us select the length of double pipe superheater for the following design conditions; water cooling system; 90F condensing refrigerant temperature; 30F evaporator temperature; flow of Freon-12 per minute, 15 lb; 1⅜-inch O.D. suction line.

Solution: In Fig. 4, find 15 on pounds per minute F-12 gas scale and drop down vertically until the evaporator temperature 30F line. Since the difference of the condenser temperator and the evaporator temperator is 90 — 30 or 60, move horizontally to the right to the 60F temperature difference line, and then down to the 15F lb per minute Freon-12 flow. Move horizontally to the right and find 9.2 ft as the length of the superheater.

For a more complete discussion of suction gas superheaters for Freon-12, see H&V, March, 1953, page 82.

Presented in the previous article is the solution of a design problem, and a chart from which one can determine the pounds of Freon-12 that are circulated per minute per ton of refrigeration for various evaporator and condenser temperatures. With this chart, one can find the total pounds of refrigerant that is circulated per minute before one uses Fig. 1 to 4 for determining the superheater length.

Also of interest in the March article is a chart showing suction gas pressure drop for shell and coil superheaters.

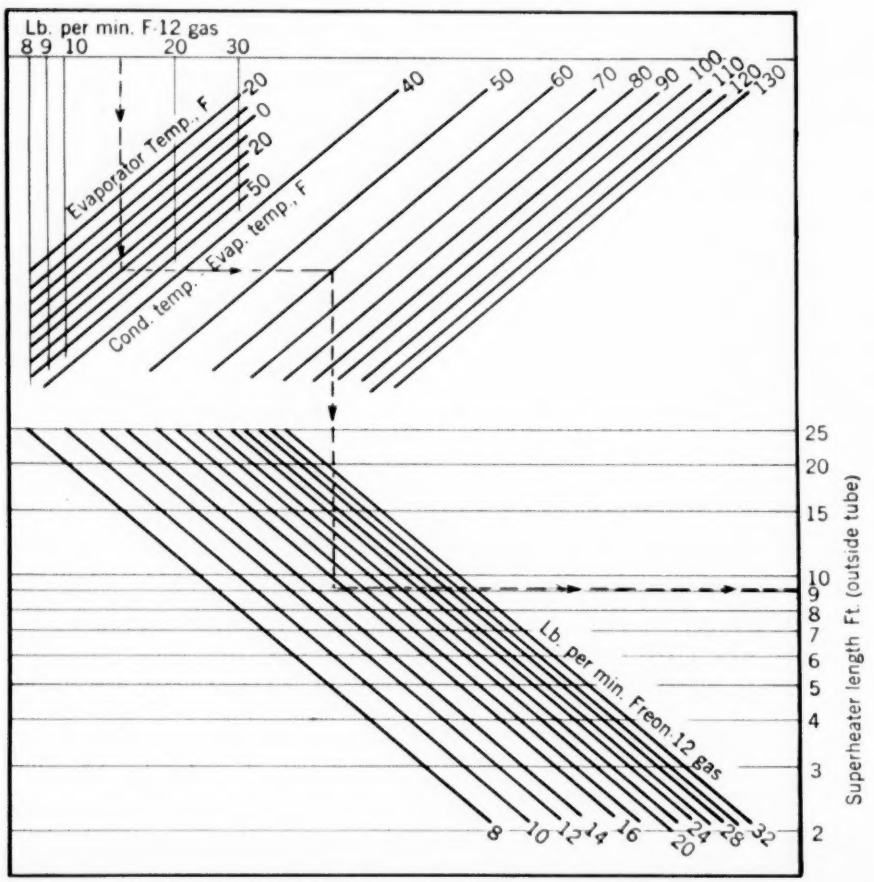


Fig. 4. Superheater ratings for 1⅜-inch x 1⅝-inch double pipe superheater.

What Would You Do?

Replies to engineering and operating problems of interest to the industrial plant engineer

Conducted by
NATHAN N. WOLPERT
Associate Editor

FIRE protection is a problem that constantly confronts every industrial plant engineer. How the water supply is run into the building and the arrangement of piping to standpipe outlets is governed by regulations established by local laws and fire insurance interests.

A problem regarding a standpipe system for a multi-story industrial building is the basis of this month's discussion. On this page are listed the problems scheduled for coming issues. Should you have a problem that you would like to see treated in this department, or if you have some comments that you would like to add to the coming discussions, the Editor will be pleased to hear from you.

This Month's Problem

A 3-story building is to have a standpipe system installed. Is it possible, as this is only a 3-story building, to have the system served directly from the street main without a roof tank? How would the service line be connected in the basement?

This Month's Problem

If it can be demonstrated to the authorities by actual prescribed tests, that at all hours of the day and on all days, there is sufficient pressure in street or highway mains to maintain a minimum static pressure of 15 psi at the highest hose outlet in the building to be supplied, a direct connection to such street main is accepted as a primary source of supply for a standpipe system. Or, in buildings 40 ft or less in height and 20,000 sq ft area, a 4-inch street main connection to a street main which

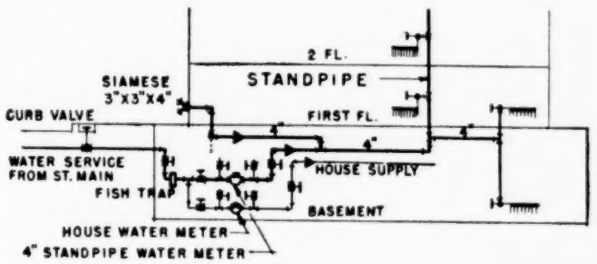


Fig. 1. Standpipe system with a compound meter.

is fed two ways, or 4-inch connection to both of two street mains located in different streets, may be used as a primary source, provided that a minimum static pressure of 25 psi will be maintained at all times at the highest standpipe hose outlet. The cutting off of either street main must not interfere with the supply from the other.

When metering such connections to street mains is required or is desired, a special compound type meter is used. This consists of a full size passage containing a turbine type meter, which produces practically no loss of head when full flow is occurring during operation of the standpipe system, and a small bypass containing a disc type meter to record the flow of small amounts of water used at other times. An automatic valve diverts the flow through the bypass until the flow becomes large enough to cause the automatic valve to open and thus permit the large flow through the full size passage. Such meters must be approved by the authorities. Fig. 1 shows a standpipe system in which a compound meter is installed.

Mortimer Freund
Eadie, Freund & Campbell
Consulting Engineers
New York, N. Y.

The information supplied is from the rules and regulations governing fire standpipe systems in New York City. Although drafted for local regulation, they are good criteria to follow for projects that are remote from the jurisdiction of the Department of Housing and Buildings of New York City. In all, there are sub articles 1 to 15, inclusive, relating to Article 16 of the building code which relates to standpipe systems.

Every standpipe system shall have a primary water supply constantly available or made available automatically when the hose valve at any outlet is opened, or when a control station functions. Such primary supply may be from one or more gravity tanks, from pressure tanks, from a direct connection to a city water main or

Problems for Coming Issues

May Issue

We have had some trouble from an unsatisfactory dust exhaust system which serves units for grinding and polishing small parts. Considerable amounts of dust collect on the floor near the grinders, in spite of protective hoods. What system would you suggest? What quantities of air should be removed for satisfactory results?

June Issue

How much temperature will a squirrel cage motor stand? Some of our motors after they have been operating for some time are exceedingly warm to the touch and I am alarmed that it may break down the insulated coatings on the windings. What is generally considered an allowable temperature limit?

private yard underground water main, or in buildings not exceeding 75 ft in height, it may be from an automatic pump.

Combinations of two or more of these recognized methods shall be made and in making such combinations the siamese hose connections shall be considered as a source of supply. A building 45 ft or less in height, other than a theater with a stage, shall not be required to have a siamese connection, except when such a building is one of a group of buildings and has cross connections to the standpipe equipment of one or more of the other buildings of such group.

A direct connection to a city water main shall be acceptable as the primary supply to a standpipe system provided the Department of Water Supply, Gas and Electricity certifies that such main is capable, between 5:00 a.m. and 8:00 p.m. on a normal working day, of maintaining a flowing pressure of at least 15 psi at the highest hose outlet when a street level hydrant supplied by the main and located within 250 ft of the structure is discharging through a 2½-inch open hydrant butt at the rate of at least 500 gpm. An exception is that in any building 40 ft or less in height and 20,000 sq ft in area a 4-inch direct connection to a street main is used that is fed two ways. Or one 4-inch direct connection to each of two street mains on two street fronts may be used, each main so fed that the shutting off of one will not interfere with the supply of the other. It is assumed that there is sufficient pressure in the street main or mains to maintain a minimum of 25 psi static pressure at the highest hose outlet.

Each service, supplying directly a standpipe system or a fire pump, shall be equipped, under the sidewalk, with a control valve in a flush sidewalk box of approved type located within 2 ft of the front wall of the building or as otherwise provided in the rules of the board. The purpose of each such control valve shall be clearly indicated by the word "Standpipe Supply Control" cast in the cover of the flush sidewalk box.

For additional exact minimum requirements of the code for standpipe installations in buildings of various heights, areas and occupancy, and for all rules and regulations governing standpipe systems, the entire Article 16 should be carefully reviewed to assure that all applicable requirements are provided in conformity with the regulations.

Walter C. Knight
Executive Engineer,
Guy B. Panero Engineers

New York, N. Y.

It may be helpful if I quote from the rules and regulations regarding water supplies published by Crosby-Fiske-Forster in their Handbook of Fire Protection.

"Minimum city water and fire pump supplies for standpipes for use by fire departments or specially trained men (2½-inch hose and 1⅛-inch nozzle) should be not less than 250 gpm for one riser and at least 500 gpm in buildings where two or more standpipes are required for at least 30 minutes. The supplies should be sufficient to deliver for one hour a pressure of 40 to 50 psi at the topmost 2½-inch outlet with a 1⅛-inch nozzle. No water supply should be accepted which provides less than 20 psi flowing pressure at the topmost outlet (not including roof outlet). The minimum supply from fire pump or tank should be: Fire pump, 500 gpm; pressure tank, 4,500 gal; gravity tank, 5,000 gal.

"At least one fire department connection should ordinarily be provided for each standpipe riser. In some instances, this may not be in strong mill yard systems.

"Minimum supplies for standpipes used for first aid protection should be 70 gpm flowing at sufficient pressure to provide two good streams. The pressure should be sufficient to give 25 psi at the highest hose outlet, and the minimum requirement is 12 psi with 70 gpm flowing. The supplies should be sufficient for two hose streams for 30 minutes."

Since I do not know where the plant mentioned is located, no specific local requirements can be quoted. However, the local fire department or building department may have jurisdiction and their rules should be followed. A 3-story building should have sufficient pressure at the topmost outlet to meet the requirements stated. Connections to the service line in the basement are usually installed in accordance with the requirements of the local authorities.

Harold Herkimer
Chief Engineer,
Raisler Sprinkler Div., Raisler Corp.

New York, N. Y.

Fig. 2 is a sketch indicating the proper hook-up for a fire line in the basement of a building. Since the building is a three-story structure, we can assume adequate water pressure and therefore, a roof tank will not be required.

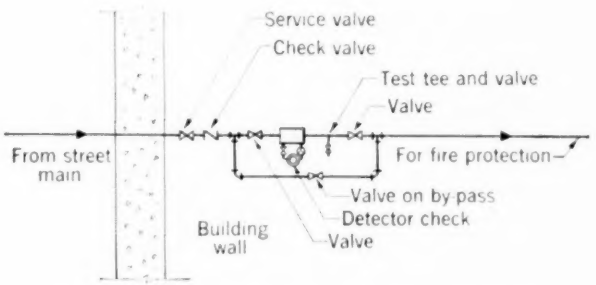


Fig. 2. Fire line installed in a building basement.

Roof tanks are installed when street pressures are insufficient, or when a building is of such size or scope that a tank is needed. In any event, these requirements are determined by the local authorities, such as fire department, insurance underwriters or the existing local fire code.

Louis Blendermann
Engineer

Glen Cove, N. Y.

Piping Hookup Details

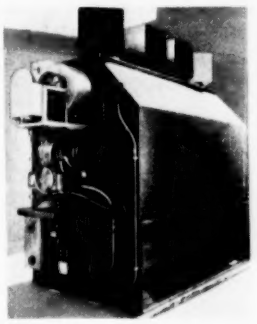
Attention is directed to the piping hookup details for service hot water supplied at two temperatures, on pages 9 and 10 of this issue. These detail sheets are now a monthly feature and will cover a wide range of subjects.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite page 147 for securing additional information on items described in this department.

Direct Fired Heater, 12 Sizes

A complete series of self-contained automatically operated heating systems, in 12 sizes, ranging from 200,000 to 2,000,000 Btu per hr output, has been developed by National Heater Co., St. Paul, Minn.



Termed the model H, the automatic heating system features four way heat discharge heads and floor line return air grilles which provide working level comfort by controlling the direction and extent of heated air circulation.

Heat exchangers on the unit are of welded, one-piece steel construction. Full chrome-nickel stainless steel firebox of teardrop design, headers, and multiple convector tubes are enclosed in heavy insulated casing formed to heater contour. Design of the heat exchangers utilizes the direct flame-metal-air principle of heat transfer for maximum efficiency.

Units are designed for light oil, heavy oil, gas or combination gas-oil firing and are intended for industrial and commercial construction.

More Information? Circle Item 1 on postcard, page 147

Tube Hanger Can Be Adjusted

The new Berkshire copper tube hanger, designed for use in permanent tube fastenings, is manufactured by Armart Mfg. Co., Pittsfield, Mass.

Hangers are manufactured in six lengths, ½, ¾, 1¼, 1½, and 2 inches, for all tube sizes. They can be bent, twisted, and formed around curved timbers or obstructions or may be hung around other pipe supports without distortion, cracking or loss of strength.

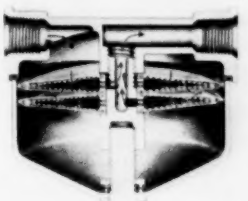
Tensile strength tests in excess of 1000 psi have been made without serious distortion. The hangers eliminate squeaks and creaking sounds due to expansion and contraction of tubes. A height adjustment slot allows one inch adjustment up or down, depending on the pitch of the pipe, without removal of fastening nails. A hinge enables the hanger assembly to be made with one hand, and only one tightening screw is required.

Hangers are made of fine grain, dead soft temper steel, heavily copper-plated to eliminate electrolytic action and to protect tubing from corrosion and wear.

More Information? Circle Item 2 on postcard, page 147

Oil Filter Has Rayon Element

A new fuel oil filter, using an element consisting of a rayon non-woven fabric and operating on the principle of surface filtration, is introduced by Sparkler Mfg. Co., Mundelein, Ill.



Surface filtration is said to prevent the quality of filtration from degenerating as the filter accumulates dirt from the oil.

Employed in its line of OB filters for filtering fuel oil between the storage tank and burner, the new filters cover a complete line of burners from small space heaters to industrial burners.

More Information? Circle Item 3 on postcard, page 147

Permanent Magnet Motor

A new permanent magnet motor, incorporating a completely symmetrical armature winding, is announced by Barber-Colman Co., Rockford, Ill.

Speeds obtainable range from 5,000 to 20,000 rpm, and motors for up to 115 volt d-c operation can be supplied. Dynamic braking stops motor from 10,000 rpm in approximately 10 revolutions. Frame size is 1½ inches in diameter by 2 3/16 inches in length.

These motors are suitable for many industrial applications such as fan and blower drives.

More Information? Circle Item 4 on postcard, page 147

Sill-Line Radiation Cabinets

The Series 500 Syncretizer, a sill-line radiation convector unit combined with a cabinet containing shelves and compartments for storage, is introduced by John J. Nesbitt, Inc., Philadelphia, Pa.

Open and closed cabinets are available in 2, 3, and 4-foot lengths and 28 and 32-inch heights. The shelves will accommodate materials up to 11½ inches high. Cabinets are made of 16 gage steel.

Air is drawn through the recirculating grille at floor level, travels under the bottom shelf, is heated by the finned tube, and is discharged through the grille at the top. Two fin sizes, two cabinet heights, and single or double tiering of the heating elements provide a wide range of capacities. The heating medium used can be either steam or hot water.

Piping compartments, made to match the storage cabinets may be employed to provide space and access for control valves, accessories, or piping. These compartments may be used at either or both ends of the storage units.

More Information? Circle Item 5 on postcard, page 147

2-Ton Year-Round Conditioner

A new, low-priced year-round Weathermaker unit, designed specifically for complete home air conditioning in the $7,500 and up mass residential market is announced by Carrier Corp., Syracuse, N. Y.

Selling for $600 to $900 more than a good forced warm air heating system, the unit measures 37 inches square in floor area and stands 62 inches high. It can be installed in a closet 42 inches square with an access door in front.

Providing two tons of cooling and dehumidifying capacity plus winter heating and year-round filtered air circulation, it is packaged in the single closet size cabinet.

Burners are available for heating with natural, mixed, manufactured, or LP gas, or with oil. For areas where water is scarce or expensive, an air-cooled condensing attachment is available, eliminating water consumption altogether.

Ease of installation is a design feature. Conditioned air can be ducted from the top of the unit in any combination of four directions or straight up. Return air can be brought to the back, bottom or side of the unit. All components can be removed or serviced and all connections made from the front of the unit.

A single thermostat, mounted in any convenient location, controls both heating and cooling, and a switch on the thermostat can be used to shift the unit from summer to winter operations.

More Information? Circle Item 6 on postcard, page 147

Submersible Cellar Drainer

A submersible cellar drainer which may also be applied to the draining of boiler rooms, tunnels, and elevator pits, is manufactured by The Deming Co., Salem, Ohio.

The entire unit can be fully submerged without damaging the motor which is sealed in completely by the stainless steel motor case. There are no floats to adjust. Motor starts when the water level raises the stainless steel motor case. Its switch is completely automatic and sealed inside motor case.

Each unit is furnished with age-resistant and waterproof 11 foot cord and plug. Pipe connections are 1¼ inch. The unit is 16 inches in height and will fit into an 11 inch diameter sump. Identified as Fig. 4667, the unit ranges in capacity from 1200 gph against a 22 ft head to 3000 gph against a 5 ft head.

The centrifugal pump is bronze with a hard rubber semi-open impeller. The solid bronze bottom base is surrounded by a perforated brass strainer to prevent refuse from interfering with the impeller.

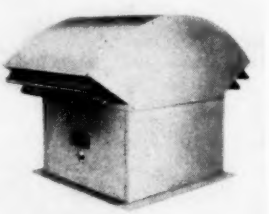
The rigid clamped connection between pump and motion assures perfect alignment. No set screws are used.

The motor is ⅓ hp, 115 volt, 60 cycle, 1750 rpm, split phase. It has two grease-sealed lifetime, lubricated bearings. Overload protection with automatic reset protects motor against improper voltage or overload.

More Information? Circle Item 7 on postcard, page 147

High Velocity Roof Ventilator

Its Power Line heavy duty, high velocity roof ventilator for industrial construction is introduced by Chelsea Fan and Blower Co., Inc., Plainfield, N. J.



Primarily used as an exhaust fan, the unit can be adapted for fresh air supply. Housing and hood are made of heavy gage steel, undercoated with noise deadening material for quiet operations.

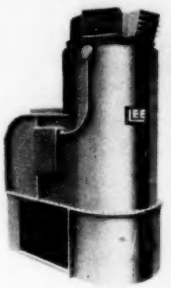
Ventilators are available in sizes 12 to 48 inches diameter for a range of capacities from 1300 to 20,000 cfm of free air and 860 to 14,500 cfm against ⅛ inch static pressure.

Automatic built-in louvers act as backdraft dampers. Fans are available in direct and belt drives, and totally enclosed or explosion-proof motors are used.

More Information? Circle Item 8 on postcard, page 147

Space Heater in Six Models

A universal duty space heater, designed for commercial and light industrial applications, is produced by Lee Corp., Wilmington, Del. The heaters are completely shop assembled and unconditionally guaranteed for one year.



They come in six standard models: stoker fired for anthracite or bituminous coal, light oil fired, gas fired, heavy oil fired, and combination light oil and gas. Standard equipment and controls include separate induced draft fan and a stainless steel or refractory combustion chamber. They are rated at output capacities ranging from 300,000 to 1,500,000 Btu per hour. Cfm delivery ranges from 3500 to 17,000.

Units have adjustable outlets which may be moved to suit conditions. The flow heat exchanger is designed to whirl the air at high velocity. A separate driven exhauster is included to fan the blower with cold air, and it requires only a vent stack.

All units have automatic controls totally enclosed in a panel on the housing.

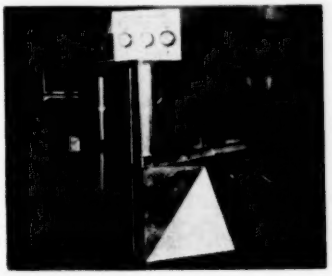
To put a new heater in service requires only supplying a vent stack to the atmosphere, connection of electric service wires to the control panel, and connection of fuel lines to the burner.

More Information? Circle Item 9 on postcard, page 147

Counterflow Heat Regenerator

A new heat regenerating method, utilizing a balanced counterflow principle, is placed on the market by Therm-O-Wheel, Inc., New York, N. Y.

It is claimed by the manufacturer that placing the unit in the exhaust air stream will generally enable a 90% heat recovery to be obtained. The unit comes in five models for handling 3,000 to 20,000 cfm of air. All units are 26 inches deep, and the surface area varies from 53 inches square to 128 inches square.



Exhaust air is blown through the upper half of the unit and ducted out of the building. In passing through the metal wool contained in the unit, heat is extracted from the outgoing air. Fresh air is blown through the bottom half of the wheel at the same time. The wheel revolves slowly, and heat previously transferred to the metal wool is picked up by the incoming air stream. The same volume of air comes in as is exhausted.

The wheel can also be used to maintain lower temperatures than prevail on the outside, such as in brewery ventilation.

More Information? Circle Item 10 on postcard, page 147

Filters for Small Pipe Lines

Four new small pipe line filter models, featuring one-bolt accessibilty for quick inspection and cleaning without removing filters from the line, are announced by Dollinger Corp., Rochester, N. Y.

Designed for installations requiring 40 psi maximum pressures for compressed air or gas, the filters are available in any one or a combination of the four models. They are manufactured in two sizes and each size can use either absorption pad media or radial fin inserts. The smaller size filter has a diameter of 3½ inches and a length of 6½ inches. The other is 3½ inches in diameter with a length of 10 inches and offers more filtration surface.

Series AA filters, with absorption pad media, remove traces of oil and water vapor from lines. The CH Series, with radial fin inserts, are designed to rid lines of dirt and pipe scale.

More Information? Circle Item 11 on postcard, page 147

Control Gives Instant Cutoff

A new electronic control system providing instantaneous cutoff following flame failure and a post-purge sequence is announced by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Designed for pressure atomizing burners using No. 3 oil or lighter, the system cuts off the oil flow from the nozzle within four seconds after flame failure. It then goes a step further and provides a post-purge cycle of motor operation equal to the safety switch timing of the relay.

A combination of the R8390C Protectorelay, the R482D relay, and the V4001 delayed-opening, rapid-shut-off solenoid oil valve forms the new relay.

On the starting cycle, the V4001 is delayed approximately four seconds, allowing the burner to get up to full speed before the oil valve is opened. The response timing of the R8390C to a flame failure is two to four seconds. The post purge cycle following a flame failure would be between 35 and 55 seconds.

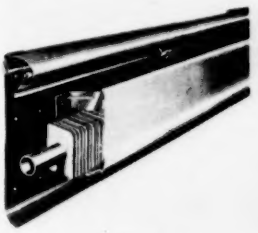
The new control system may be used with an industrial photocell mount for field application. If a burner manufacturer has an approved application, a photocell for blast tube mounting may be used.

More Information? Circle Item 12 on postcard, page 147

Hot Water Baseboard Convector

A new hidden heat baseboard convector for residential hot water heating is developed by The Trane Co., La Crosse, Wis. The baseboard convectors are suitable for installation in medium and lower priced homes, particularly in large scale projects.

An easier housework feature, which was suggested by housewives, is the concave radius curve at the base of the unit. This reverse curve eliminates a dust catching spot, and aids easy mopping and sweeping. The entire unit may be installed free standing, or it may be partially recessed, so that its face is only 1½ inches from the wall. It may be set over carpeting, floor tile or linoleum. There are no sharp corners or edges.



Instead of using grilles, there are continuous horizontal openings, uninterrupted by joints or visible supports, from wall-to-wall and around inside and outside corners. The one-piece back of the baseboard is sealed to the wall by a continuous strip of sponge rubber for insurance against streaking. The front panel is removable for installation or cleaning.

Baseboard convectors are packaged completely assembled, including joiner pieces, in lightweight cartons in 6- or 8-foot length. The one piece back-top section is drilled with mounting holes on 1½-inch centers, permitting quick attachment to any stud spacing without drilling or sheet metal screws.

The fin-and-tube heating coil is suspended on hangers that permit free expansion. The contoured front panel snaps onto the hangers without screws or bolts, facilitating easy installation, inspection and cleaning.

Dampers, generally recommended for bedrooms, may be installed initially, or later. They snap into position, held by a damper spring. Control valves that move 60 degrees from full open to close, complete the design.

More Information? Circle Item 13 on postcard, page 147

Small Pipe Heating System

A complete small pipe system offering four methods of air diffusion is placed on the market by Char-Gale Mfg. Co., Minneapolis, Minn.

Four types of registers are offered with the 4½ inch pipe system, in addition to the plenum, 10-foot tubes, and all fittings and connections required.

Sidewall register-and-box units (illustrated at right) distribute air evenly in all directions along the wall. They are adjustable and permit balancing at the register. Designed for older homes, in particular, angle baseboard out-of-wall registers include the features of the sidewall model and are installed by cutting an opening in the floor.

A floor diffuser is a third type available in this system. The diffuser achieves a fan-shape circulation pattern by having vanes set at proper angles in the rectangular register.

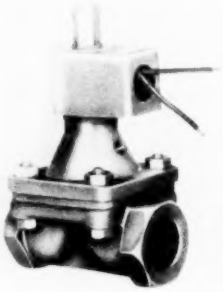
The fourth type of register available in the system is the ceiling diffuser (illustrated at left). This diffuser provides air tempering and distribution by means of a vortex action cylindrical box and correctly proportioned rings in the register itself. Air entering the box receives a circular, outward motion, producing a partial vacuum in the center of the cylinder. Room air is drawn up into the box and blended with the heated air, then expelled into the room.

Systems may be packed for complete jobs, or cartons with individual fittings and parts may be obtained.

More Information? Circle Item 14 on postcard, page 147

Pilot-Controlled Valve

A new Pilot-operated valve for use in handling highly corrosive liquids, gases, and food products, is manufactured by Automatic Switch Co., Orange, N. J.



Having two moving parts, a flexible diaphragm and a solenoid core, the unit works on the following principle: Air or liquid pressure is introduced directly from the pilot and impressed upon the diaphragm to close the valve; upon release of this imposed pressure, the line pressure opens the valve. Valve bodies are available in cast iron, bronze, or stainless steel. A sanitary body as well as rubber or glass linings are available for handling food products.

Pipe sizes range from ½ to 2 inches and the maximum temperature is 130F. Maximum height of the valve, from the top of solenoid to the bottom of body, for the screwed end construction ranges from 6 5/16 to 8⅝ inches. For flanged end construction, heights vary from 7⅜ to 10 1/16 inches.

These valves can be changed from a normally open to a normally closed position, or the reverse by interchanging separate source connections to the pilot. No change of springs or other adjustments are necessary.

More Information? Circle Item 15 on postcard, page 147

Three Direct-Driven Blowers

Three new direct-driven blowers, models DD9-6, DD9-9 and DD9-10, designed for furnaces with 50,000 to 125,000 Btu per hr input capacity, are placed on the market by The Lau Blower Co., Dayton, Ohio.

These new units are quiet, efficient in operation, and are available with four angles of discharge.

Another feature is that one blower gives a choice of capacity and operation. Optional equipment includes a five-speed control for balancing of the heating system. Illustration shows relation of size of unit to the human body.

More Information? Circle Item 16 on postcard, page 147

No Moving Parts in Exhaust Head

A new exhaust head without moving parts or filters has been developed for industrial stacks by The V. D. Anderson Co., Cleveland, Ohio.

This unit is designed to clean up exhaust steam and vapor so that no nuisance particles such as troublesome oil and process liquors, are vented to the atmosphere.

The entrainment laden vapor entering the purifier is engaged by a stationary centrifugal element which imparts a carefully controlled, but rapid, rotational motion to the vapor. This action guides all dirt particles, oil, and water outward to the walls of the purifier. Here it is drained and ejected. The clean, dry steam continues upward and is discharged to the atmosphere.

Although fabricated to specification, standard models have a slip-on or flange connection for the stack and a threaded connection for the drain, in addition to a fabricated steel body and a stainless steel centrifugal element. The unit is guaranteed 99% effective and the manufacturer states that the greater the velocity through the unit the greater the operating efficiency.

More Information? Circle Item 17 on postcard, page 147

Fly Ash Collector Regenerates

A new regenerative fly ash collector which is installed as a single vertical flow unit in a steel stack is manufactured by Breslove Separator Co., Pittsburgh, Pa.

These units are designed to remove fly ash, soot, and cinders from stack gases. They consume no power and do not require a fan. They have no moving parts, operating by centrifugal separation from the natural draft of the stack itself. The only attention required is periodic emptying of the hopper.

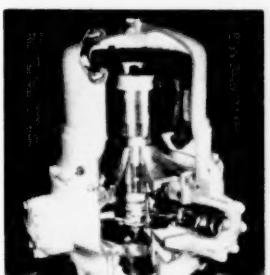
The operation of the collector involves three basic stages. First, the gases are passed through an accelerating zone; second, at this high velocity the gas is whirled at extreme speed. The centrifugal force produced throws the soot, cinder and fly ash particles to the outside where they are extracted; third, the cleaned, particle free gas passes into the decelerating zone which regenerates or recreates the original pressure or draft. The natural or chimney draft, at the end of the system, differs from the original draft by only a small amount.

The fly ash is removed in a dry condition, free-flowing by chute to a discharge gate, where it is emptied into containers or wheelbarrows. Material diagraming the operating principles and illustrating and describing applicable installations is available.

More Information? Circle Item 18 on postcard, page 147

Accessible Hermetic Compressor

A type of hermetic refrigeration machine, designed to give quiet, maintenance-free performance in small home, store and office air conditioners, is announced by The Trane Co., La Crosse, Wis.



The accessible hermetic compressor will be built in 5 and 7½ ton capacities using Freon-22 refrigerant and a 3-ton capacity using Freon-12. The compressor is designed for self-contained air conditioning units. It combines the advantages of hermetic construction with accessibility of valves, strainer, and lubricants.

Aluminum pistons and connecting rods contribute to vibration-free operation of the unit. The cast iron crankshaft is statically and dynamically balanced. All parts of all models, except motor and crankshaft, are interchangeable.

More Information? Circle Item 19 on postcard, page 147

Powered Roof Fans

Hyduty Type N.T. roof fans for ventilating institutions and industrial and commercial buildings are manufactured by Davidson Fan Co., Newton, Mass.

A new feature of these fans is the arc welding of the wheels, a design said to make the wheel strong while reducing torsional changes. The wheel shaft of the V-belt driven fan is carried by a heavy ball bearing assembly bolted to the bridge work which also supports the motor. This bridge work floats on four dampeners which absorb vibration and magnetic hum in the motor. The frame also supports a housing which can be furnished in copper, aluminum, stainless steel and monel.

Self-acting louvers, which open when the fan is started and close when it is stopped are offered as an optional feature at extra cost.

A complete line of standard sizes are offered in various capacities, and special features or designs may be incorporated upon consultation with the manufacturer.

More Information? Circle Item 20 on postcard, page 147

Liquid Level Control Valve

A new pressure reduction valve, designed to maintain a low and sensitive outlet pressure, is developed by Helco Products Corp., Santa Monica, Calif. This control valve can be adapted to uses in diverse types of equipment where a steady water or other liquid level is to be maintained automatically. It takes the place of float valves wherever a closed system is desirable because of sanitary requirements or corrosive conditions.

Operating in a range of inlet pressure from 5 to 260 psi, the valve can bet set to maintain a steady water level in a range from 5 to 20 inches.

The firm will be glad to cooperate in adapting its valve to meet specific needs, and will furnish samples upon written request.

More Information? Circle Item 21 on postcard, page 147

Electric Baseboard Units

A new Circle Air convection electric baseboard unit, which is a completely self-contained unit that can be taken direct from the package and installed with no assembling, is placed on the market by Paley Mfg. Co., Brooklyn, N. Y.

Units are available in three models all 10 inches high and 3 inches deep. Lengths are 28, 36 or 48 inches, and all three models can be recessed to lie flush with baseboard, or can be installed standing free from wall. All models can be had with efficient built-in single pole thermostat.

These units employ a fin type heating element which carries a five year guarantee. Air is warmed completely and evenly and circulates through room by natural convection principle.

More Information? Circle Item 22 on postcard, page 147

3Hp Summer Air Conditioner

Distribution of a 3 hp summer air conditioning unit, built in three sections so that it can be adapted to various types of cooling applications in home, office, and store cooling, is announced by York-Shipley, Inc., York, Pa.

The base unit contains the cooling unit section. The complete air conditioner is hermetically sealed and mounted in a cabinet 24 inches wide by 22⅛ inches deep and 40 5/32 inches high. Two 16 by 25 by 1-inch filters are located on the air intake side. The air passes over a 3-row aluminum fin cooling coil and is discharged through the top of the unit. Another feature of the unit is the cleanable water-cooled condenser.

For installations where a blower is required, a blower unit section 15 inches high is mounted on the cooling unit. The blower is rubber-mounted for quiet operation.

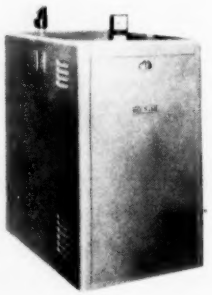
A grille unit mounts on the blower section for ductless installations. It is 14 inches high and makes the complete unit 72 inches high. The grille is mounted at an angle for maximum air distribution without drafts.

More Information? Circle Item 23 on postcard, page 147

Oil-Fired Burner-Boiler Unit

A new oil heating unit for residential hot water and steam heating, the OB-18, is introduced by Weil-McLain Co., Michigan City, Ind.

The unit consists of a round cast iron boiler and a flange mounted burner. It is designed so that the back and forth fire travel is balanced through the long flue ways.



Rated at 134,000 Btu per hr output, the burner has a capacity of 1.38 gph of oil. Its overall dimensions are 25½ inches wide, 40 inches deep, and 43½ inches high.

Hot water for domestic use winter and summer is available with the storage tank or tankless type hot water heater built into the combination steam and water dome of the heating unit. The capacity of the tankless type heater is 3.5 gph and the storage type capacity is 90 gallons every 3 hours.

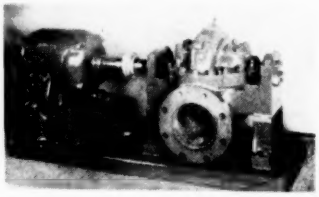
Other features of the unit are a refractory combustion chamber which is precast for assembly on the job; fiber glass insulation; front jacket panel which may be quickly removed for easy cleaning and servicing of boiler, burner and controls; and a base plate which provides free circulation of air beneath the boiler while permitting safe installation of boiler on any type of floor.

Standard equipment of the unit consists of the burner, combustion chamber, thermostat, stack control, aquastat for water or pressuretrol for steam, and a balanced draft damper.

More Information? Circle Item 24 on postcard, page 147

Centrifugal Pumps in 19 Sizes

A new series of single stage, double suction centrifugal pumps, featuring renewable stuffing box bushings, sealed bearing housings, cowl-type glands suitable for use with quenching liquids, stainless steel impeller keys, Teflon water seal rings, die-formed stuffing box packing, and corrosion-resistant gland bolts, is announced by Goulds Pumps, Inc., Seneca Falls, N. Y.



Designated the Fig. 3405 line, there are three different assemblies of shafts and rotating parts. However wide interchangeability of parts in each assembly makes it possible to provide 19 different pump sizes in the three groups. In addition, a locking design of shaft sleeves makes it possible to change the direction of impeller rotation in the field without additional parts. Thus, 38 different pump combinations are offered in the new series. The pumps have capacities ranging from 200 to 6,400 gpm, with heads up to 260 feet.

The pump casings are horizontally split, and removal of the upper half permits inspection, maintenance, and removal of the entire rotating element without disturbing the suction and discharge piping, or pump and driver alignment.

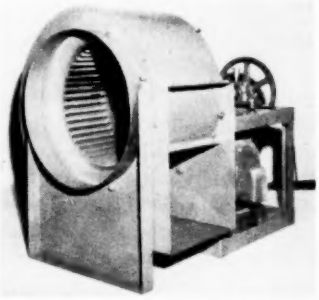
Packed type stuffing boxes are standard, but mechanical seals of either single or double types can be furnished on order. Changes from the conventional stuffing box to the mechanical seal, and vice versa, can be made easily in the field.

Motor drive bedplates are standardized, with all bedplates being jig-drilled and tapped to accommodate all motor frames within the scope of the bedplate. This facilitates change of motors in the field without the added expense of drilling and tapping for the new motor.

More Information? Circle Item 25 on postcard, page 147

Adjustable Blower Exhausters

A line of blower exhausters, constructed to permit easy adjustment in the field for any angle of discharge for universal adaptation, is announced by Brundage Co., Kalamazoo, Mich.



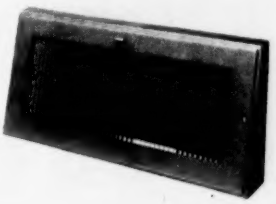
The unit is applicable for use with air conditioning equipment, in industrial ventilation and in heat, fume, or smoke removal. It can be used indoors or outdoors. Its table top motor mount can be adapted to any type or size or motor frame. The mounting table is equipped with a hinged pivot to maintain belt tension.

Inlet dimensions correspond to standard duct size for connection without special transition sections. The blower wheel is assembled by a hot riveting process designed to make practically a one piece construction.

More Information? Circle Item 26 on postcard, page 147

Baseboard Diffuser Registers

A new line of baseboard out of wall diffuser registers for 4, 4½ and 5 inch pipes has been placed on the market by United States Register Co., Battle Creek, Mich.



In these units, vertical diffuser grill bars are set at correct graduated angles to spread the air flow. They are designed so that the air stream projects outward and upward and will not come up under or behind the curtains or drapes. They are furnished with rubber sealing gaskets to prevent leakage and wall discoloration. All units are equipped with a balancing set-lock.

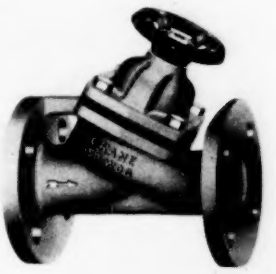
Units are furnished complete with head which is equipped with lugs for attaching to the wall with wood screws.

Registers are available in three sizes: 10 x 5 inches for 4 inch round pipe, for 4 or 4½ inch round pipe, and 14 x 5 inches for 4, 4½, or 5 inch round pipe. These serve the following sizes of round pipe: 4 inches, 4 or 4½ inches, and 4, 4½ or 5 inches, respectively. They are available with the following finishes: metallic, white or ivory, and bronze, nickel or cadmium. Prices range from $6.30 to $9.50 and the units come ten per case.

More Information? Circle Item 27 on postcard, page 147

Packless Diaphragm Valves

The addition of several new body, diaphragm, and lining materials to its line of packless diaphragm valves is announced by Crane Co., Chicago, Ill.



These valves are now regularly available with cast iron, brass, aluminum, or 18-8 Mo bodies and disc holders; and with diaphragms and disc inserts of Neoprene, Buna-N, and soft natural hard rubber linings. Specially prepared valves for vacuum, oxygen, and acetylene service are also now regularly available.

A feature of the diaphragm valves is the separate diaphragm and disc construction. Since the diaphragm is not used for seating, it is not subjected to the cutting, crushing, and abrasion that lead to rapid wear. Closure of the independent disc will prevent escape of line fluids even if the diaphragm should fail.

More Information? Circle Item 28 on postcard, page 147

Refrigeration Compressor

A four-cylinder, V-type refrigeration compressor for air conditioning applications is announced by Westinghouse Electric Corp., Boston, Mass.

Called the CLS-2100, the new hermetic unit develops 56.8 tons of refrigeration. The compressor has a dual voltage, 60 cycle motor that can be field connected for any one of three voltages.

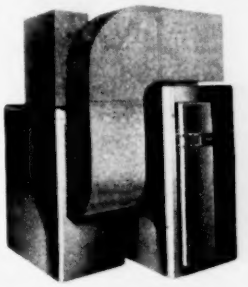
Control and safety devices, including an automatic reset, spring-loaded, high-to-low side refrigerant relief valve, are furnished as standard equipment. In addition, the compressor has a reversible oil lubricating pump that supplies oil to vital bearing surfaces regardless of motor rotation direction.

The compressor is completely accessible for field service and maintenance. It uses Freon-12 refrigerant.

More Information? Circle Item 29 on postcard, page 147

Year-Round Air Conditioner

A new residential cooling unit, the Oil-O-Matic, designed for use with forced air heating installations, is introduced by Williams Division, Eureka Williams Corp., Bloomington, Ill. The unit is designed to furnish complete residential year-round air conditioning.



Available in 2 and 3-ton units, a 5-ton unit will soon be added. These units utilize the duct system, air filters and blower of the forced warm air heating plant.

A heavy gage steel cabinet insulated with 1-inch thick, foiled back fiberglas, encloses the unit cooling machinery. The entire unit occupies 5½ square feet of floor space and may be installed next to, or remote from, the heating installation in either utility room or basement.

No seasonal change-over servicing is required, and the sealed compressor carries a 5-year warranty. An auxiliary blower may be installed in the unit when additional air delivery is needed.

The unit is fully automatic and thermostatically controlled. The water-cooled condenser utilizes the counter-flow principle and the cooling coil is made of copper tubing with aluminum fins. All conditioners are shipped from the factory as package units.

More Information? Circle Item 30 on postcard, page 147

Welded Aluminum Slinger Rings

Welded aluminum slinger rings, designed to adapt all popular sizes of its assembled Airistocrat fan blades for use as condenser fans for room air conditioners, are made by The Torrington Mfg. Co., Torrington, Conn.

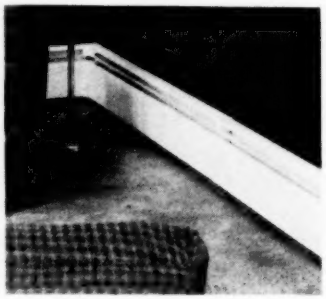
A production method of rolling a ring from an aluminum strip is said to permit a wide variety of welded ring diameters and eliminate costly tooling for various sizes.

While the rings and aluminum tabs with which they are riveted to the fan blades can be made for any diameter above 10 inches, the rings usually are used with the firm's 10, 11 and 12-inch fans. Those types achieve the operating performance against pressure that is required in air conditioning applications.

More Information? Circle Item 31 on postcard, page 147

Fin-Tube Baseboard Heating

A baseboard radiation system for homes, apartments, institutions, and commercial installations is announced by John J. Nesbitt, Inc., Philadelphia, Pa.



To be used with steam or hot water heating systems, the finned-tube sections are available in one foot increments from 2 to 10-feet in length. The casing dimensions are 9 9/16 inches in height and 2¾ inches in depth. These enclosures are available in 6 and 8 foot lengths which may be cut on the job to adapt for varying requirements.

When used with steam, the heating elements have a capacity of 955 Btu per hr-ft. When used with hot water, the capacity varies from 540 Btu per hr-ft with an average water temperature of 160F to 915 Btu per hr-ft with a water temperature of 210F.

Accessories include supporting brackets, end caps for terminal points such as doorways, wall covers, joint trim for combining two lengths of enclosures, and inside and outside corner joints.

More Information? Circle Item 32 on postcard, page 147

Packaged Cooling Unit, 4 Sizes

A packaged cooling unit, equipped with built-in evaporative condensers, in 2, 3, 5 and 7½ ton sizes, is announced by Bal-Air, Inc., Nashville, Tenn.

Dimensions of the unit are 30 inches wide, 25 inches deep and 60 inches high. Extra insulation is added to deaden any objectional operating sounds. Each unit is wired, charged with gas and equipped with thermostat. Cooling coil, blower, and filter section is detachable so the high side package may be either remote or installed complete with the air handling unit to make one package.

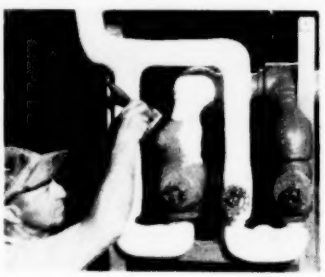
The unit may be installed as one package in basements next to the furnace or in the utility room. The high side package evaporative condenser may be installed in the outside garage, in the attic, or on the outside of the house at any location, while the cooling coil section may be installed in the regular cooling and heating duct. This cooling coil may be installed by suspending it in the regular duct trunk and can be located in the basement, utility room, or in the attic. In such type installations, a condensation drain will have to be provided.

While the units were developed primarily for domestic use, they are applicable for many commercial uses. By installing the unit next to an outside wall or back room wall, the evaporator supply and outlet duct could be simply installed, so that the complete air conditioning package may be installed in stores, restaurants, or offices. As remote high side packages for other commercial uses, these units can be used in the installation of walk-in coolers, cutting rooms, ice makers, freezers and any other related type commercial installation.

More Information? Circle Item 33 on postcard, page 147

Plastic Coating in 6 Colors

A new plastic coating, available in white and six colors for use as protection and identification on insulated refrigerant, cold water and steam lines and insulated equipment, is produced by the Armstrong Cork Co., Lancaster, Pa.



Called Insulcolor, the new finish can be either brushed or sprayed on. It will withstand temperatures to 160F without cracking or shrinking, and it may be used over heat insulations and cork pipe covering, and as a finish over cork-insulated air conditioning ducts.

Along with resistance to bumping and abrasion, the finish features high water resisting properties which make it suitable for either inside or outside applications. No inflammable solvents are used in the coating, so that it is safe to use on the job. When dry, it is classified as fire-retardant and it is entirely odorless. Dust, dirt, grease, oil and soot can be readily washed off its surface.

When diluted with water, the coating is usable as an adhesive for pasting down canvas, asbestos, and other lagging cloths, eliminating the need for sewing the material.

More Information? Circle Item 34 on postcard, page 147

Holder for Moisture Absorbent

A new type suspension holder for Hum-I-Dri moisture absorbent, designed to facilitate the setting up of the units as well as the removal of water from drip pails, is announced by Speco, Inc., Cleveland, Ohio.

The new standard has a sturdy loop into which a knot in the absorbent bag fits. This suspends the bag over its drip pail at a higher level, thus permitting air to circulate more completely around the unit, speeding up the absorption of moisture.

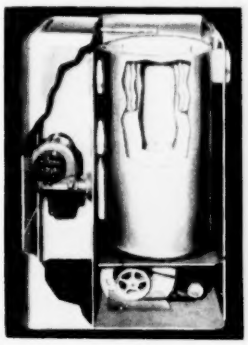
According to the manufacturer, the absorbent removes up to ten times its weight in moisture from the air without requiring baking or drying out. It is furnished in 5 and 10 pound sizes with reusable metal drip pails, and refill units are available.

For use in removing dampness from basements, closets, store rooms and kitchens, the absorbent is also said to be suitable for food processing plants, laundries, and other industrial plants constantly subject to steam and moisture.

More Information? Circle Item 35 on postcard, page 147

Furnaces Fired by Gas or Oil

A new Master Kraft packaged furnace that is easily convertible from oil to gas, or gas to oil by changing burners, is manufactured by Harvey-Whipple, Inc., Springfield, Mass.



When purchased as an oil fired furnace, the unit is called Model WLC, needing the installation of the combustion chamber, controls, and flange type Model R burner to complete its assembly.

When ordered as a gas fired furnace, the unit is called Model GF and is completely assembled with a gas burner, being applicable for use with natural, mixed, or manufactured gas.

The furnace is enclosed in a round cornered, 22 gauge, steel jacket. The heat exchanger is 12 gauge furnace steel with a refractory combustion chamber. The oil fired model is available in two sizes, 75,000 and 90,000 Btu per hr at the bonnet, while the gas fired model is available in sizes 80,000 and 105,000 Btu per hr input.

More Information? Circle Item 36 on postcard, page 147

Two-Ton Air Conditioner

A 2-ton direct-fired gas air conditioner for homes of the $10,000-$14,000 bracket, containing up to 1,200 square feet of floor space, is announced by Servel, Inc., Evansville, Ind.

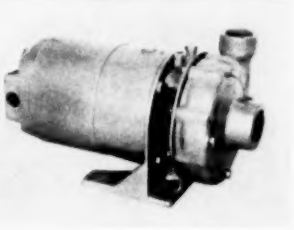
The new model requires 8½ square feet of floor space and is 75 inches high. Its gas-operated absorption unit provides quietness of operation, long life, and low installation and maintenance costs. It is delivered as a complete unit without duct work and carries a 5-year warranty.

More Information? Circle Item 37 on postcard, page 147

Close-Coupled Centrifugal Pump

A compact new close-coupled centrifugal pump, designed and developed with attention to air conditioning requirements, is marketed by Goulds Pumps, Inc., Seneca Falls, N. Y.

Listed as the Fig. 3642 pump, it delivers up to 110 gpm, and operates at heads up to 110 feet. The electric drive motors that are used range from ¼ to 2 hp. Discharge outlets are tapped to accommodate 1 or 1¼ inch pipe.



Motor and pump form a single unit that is installed by bolting the unit down, and connecting the piping and power. The impeller, of single-suction type, is statically balanced for smooth operation. It is threaded directly on the extended motor shaft and is secured by a stainless steel jam nut.

Casing is vertically split to enable inspection and maintenance to be performed without disturbing piping connections. The discharge nozzle can be turned to any one of eight positions. The pump has a mechanical seal which is protected from running dry once the pump is primed, and which prevents leakage. It does not bind the shaft, does not require adjustment, and is replaceable.

Permanent alignment of the motor and pump are assured by a machined end bracket on the motor which fits into a recessed lock on the adapter. Interchangeable parts make it possible to convert from one size to the other by changing only the impeller and casing.

More Information? Circle Item 38 on postcard, page 147

Check Valve for Fuel Unit

A new valve, called the Web-chek, designed to replace the inlet bushing of the Webster fuel unit, becoming an integral part of the unit, is placed on the market by Hold-Tite Valve Mfg. Co., New York, N. Y.

Used on both single and double stage fuel units, the valve is installed in the shop or field without the necessity of taking the pump apart.

A feature of the unit is the precision seat ring in a groove. This design, the company claims, is self cleaning, and as the sharpest edges are where circles meet, the combination of circular seat ring and ball cause a tight closure.

Due to the groove design, low vacuum is easily held, and high vacuum increases the closure area without damaging the seat ring. The valve installed in a fuel unit will hold the prime on suspended furnaces and high-boys, and may be used on all one and two pipe jobs where the oil level is below or may fall below the pump shaft level.

More information? Circle Item 39 on postcard, page 147

Pre-Mix Type Gas Burner

The Voriflow gas burner of pre-mix design, developed for gas-firing its Powermaster packaged automatic boilers, is announced by Orr & Sembower, Inc., Reading, Pa.

Gas flows through the central nozzle from the gas plenum. Simultaneously combustion air from the blower enters the air plenum tangentially, automatically controlled by the motor operated damper. Primary pre-mixing air is captured by a stationary air wheel register. This assembly directs the pre-mixing air through holes into the gas nozzle against venturi-shaped air baffles. Air and gas are thoroughly mixed while travelling through the gas nozzle. The outer secondary air ring controls the amount of secondary combustion air admitted to the combustion chamber. Ignition takes place at this point.

All components are sized for the Btu per hr content of the gas to be burned and the heat requirement of the boiler. The register assembly, the banks of air holes in the gas nozzle, the air baffles, and both primary and secondary air rings are each properly selected.

More Information? Circle Item 40 on postcard, page 147

Oil-Fired Winter Conditioners

Expansion of its line of domestic heating equipment to include oil-burning winter air conditioners is announced by Rheem Mfg. Co., New York, N. Y. The units retain the flame-shaped combustion chamber and multi-sectional heat exchanger employed in the company's gas furnaces.

Designated Model 2436 low-boy winter air conditioners, the new oil-burning units are available in 85,000, 100,000 and 120,000 Btu per hr capacities. They are fired by a pressure atomizing burner, rubber-cushion-mounted to a twelve gage steel combustion chamber. Features include a special, heat-resistant, stainless steel combustion chamber liner, fixed setting safety limit control, rubber-mounted blower and motor assembly, and a secondary air adjustment control.

More Information? Circle Item 41 on postcard, page 147

Active, Non-Corrosive Solder

A new rosin core solder, known as RTS 200, designed to be active yet non-corrosive, has been developed by Federated Metals Div., American Smelting and Refining Co., New York, N. Y.

Oxide films and corrosion products on the parts being soldered need not slow down operations, because this solder pierces such retarding agents at a very rapid rate.

Despite the activity of the flux at soldering temperature, there is no harmful corrosion residue when tested under the high humidity conditions of military specifications. Experience has shown that the flux in the new solder is just as active after standing for long periods as when used immediately. The chemicals used in new rosin core solder are commonly used in industry and have no toxicity factor whatsoever. The solder is available in a wide variety of wire sizes, compositions, and quantities.

More Information? Circle Item 42 on postcard, page 147

Expanded Air Conditioner Line

An expanded line of air conditioners, featuring new package cooling units for year around air conditioning, is announced by The Lennox Furnace Co., Marshalltown, Iowa.

Two models of the package type are included: The Stow-away, for installation in a horizontal air duct, and the flat-top, for installation where there is vertical air flow.

Both models are available in 2- and 3-ton cooling capacities. Features include ease of installation, flexibility of application, easy access and cabinets treated to resist corrosion.

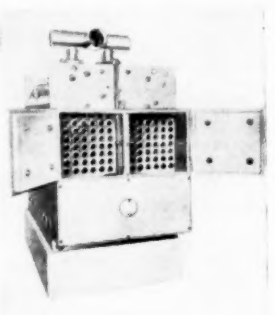
A third unit, which is of the year-round type, the GAY2 (illustrated), is available in 7 models. Gas heating input ranges from 80,000 to 200,000 Btu per hr. Cooling capacities include 3, 4½ and 6 tons.

Features of the year-round air conditioner include two stage cooling and step-starting to reduce electrical surge. These units incorporate a large hammock type air filter, floating blower, and compact design with easy accessibility. No clearance is required at sides, rear or floor.

More Information? Circle Item 43 on postcard, page 147

Boiler Installed in 2 Sections

A new steel boiler construction for the commercial field, in which the boiler is split down the middle to fit through undersized door openings and avoid head room snags, is announced by Portmar Boiler Co., Inc., Brooklyn, N. Y.



The boiler is designed to eliminate costly alterations. Requiring no welding in the field, this split sectional boiler is moved into the building in two watertight sections. Assembly is accomplished quickly as the boiler is bolted-up on the job. Made of heavy gage steel, the tubes are arranged to provide maximum heat transfer and are accessible through the front flue door for cleaning.

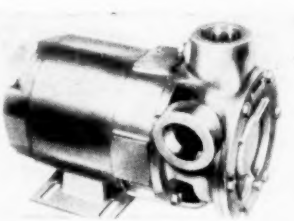
Available in twelve sizes with 876,000 to 5,100,000 Btu per hr, the unit can be oil or gas fired. Steam radiation ranges from 3,650 to 21,250 square feet and water radiation ranges from 5,840 to 34,000 square feet.

Low-waterline and low header connections are said to contribute to quiet, economical heating efficiencies. Built for apartment houses, libraries, schools and institutions, the Type C boiler can be rigged right at the breaching on the job, with return and feed headers supplied.

More Information? Circle Item 44 on postcard, page 147

Close-Coupled Turbine Pumps

A line of Apco V-type close-coupled turbine-type pumps in capacities from 3 to 30 gpm for heads of 0 to 250 feet is produced by Aurora Pump Co., Aurora, Ill.



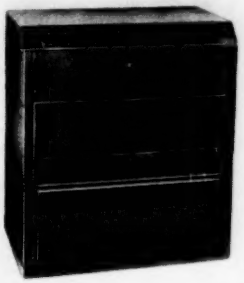
Designed to reduce the pump-motor assembly to small over-all size, the integral nature of the pump and motor shaft reduces coupling noise and avoids misalignment troubles. Four different positions for suction and discharge connections provide installation flexibility.

Wearing parts, which include the cover, inner ring, and impeller, are made of bronze to offer resistance against corrosion. Pumps are equipped with mechanical seals and have a 28 foot suction lift at sea level.

More Information? Circle Item 45 on postcard, page 147

Electric Dehumidifier

A self-contained, heavy duty electric dehumidifier, called the Moisture Magnet, which automatically removes excess water or moisture from the air of enclosed spaces in industrial plants, storage rooms, and laboratories, is produced by Air Conditioning Div., Remington Corp., Auburn, N. Y.



Except for an electric outlet, no installation is necessary, and no chemicals, duct-work, or air outlets are required. For drainage, the unit may be placed over an existing floor drain, or pails may be used for water collection. If desired, the unit may be hooked up to a drainage system, or may be caster-mounted for mobility.

Available in two capacities, the units are recommended for operation at room temperatures of 60 to 110 F. and relative humidities of 40% to 100%, and may be used singly or in multiple units.

More Information? Circle Item 46 on postcard, page 147

Venturi Circulating Tee

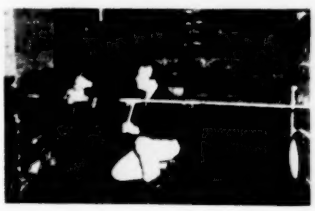
A new circulating tee for one pipe hot water heating systems is announced by Hi-Flow Products, Inc., Lindenhurst, N. Y.

This new tee has no added or moving parts. However, the unit provides high efficiency vortex venturi action coupled with simplicity of design.

More Information? Circle Item 47 on postcard, page 147

Tool Lifts, Drills, Braces

Production of a new portable construction tool called the Dril-Jak, which enables a worker to exert force up to 2,000 pounds where more than 100 psi pressure is required for drilling holes in concrete or steel, is announced by Time Saver Tool Co., Inc., Cleveland, Ohio.



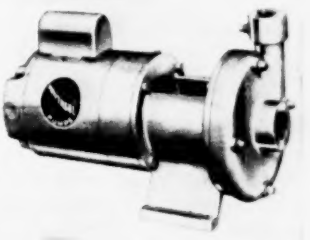
A universal drill motor clamp holds a regular drill motor in correct alignment. The mechanical friction grip action of the tool works like a simple lifting jack to force the drill motor ahead, giving maximum efficiency and cutting speed. An instant pressure release works from the lift handle, thus providing one hand control. The tool can operate in confined space or can be extended to as much as 25 feet with coupled extension sections.

It is a versatile tool for many construction and maintenance jobs, such as lifting, temporary bracing, shoring, weld positioning, or jacking to set permanent forms or braces.

More Information? Circle Item 48 on postcard, page 147

Centrifugal Circulating Pump

A new centrifugal circulating pump, designed for use in the air-conditioning industry, is marketed by Universal Mfg. Co., Berkeley, Calif.

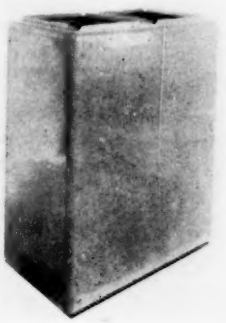


Called the Series WXH, the unit is available in a wide range of horse power ratings. It uses a standard-make motor, a precision ground shaft for smooth operation, a bronze fully enclosed impeller and single stage, and suction units. It is suitable for large capacities at moderate heads.

More Information? Circle Item 49 on postcard, page 147

Cooler for Furnace Makers

A central cooling system, designed exclusively for manufacturers of warm air furnaces, to be installed in existing systems or incorporated with new forced air furnaces, is produced by Hupp Corp., Cleveland, Ohio.



Units are available in four sizes; model H-20, a 2-ton unit recommended for handling air quantities of 840 cfm; model H-30, a 3-ton unit designed for handling 1260 cfm of air; model H-50, a 5-ton unit designed to handle 2100 cfm of air; and model H-75, a 7½-ton unit designed for 3150 cfm of air. The first two models are 22 inches deep, 37 inches wide, and 47½ inches high. The other two models are 25 inches deep, 42 inches wide, and 53 inches high, and they have side air in and top air out connections.

All component parts of the unit are readily accessible, and replacement by assemblies in the field can be accomplished easily. The compressor and motor unit is a serviceable hermetic unit. A pump down type refrigeration system with extra refrigerant, Freon 12, stored in the receiver is employed. Vibration eliminators are used on the compressor.

A cleanable tube condenser, continuous aluminum plate fin cooling coils, and a thermal expansion valve are included in the condensing unit. A room thermostat or humidistat is connected with the solenoid valve, and complete protection is provided with a thermal and current overload device.

The firm emphasizes that the units are designed specifically to be sold through manufacturers of warm air furnaces, and will not be sold through dealers or distributors. Interested manufacturers may address inquiries to Hupp Corporation, Globe Stamping Division, 1250 W. 76th St., Cleveland 2, Ohio. Dealers are requested not to make inquiry.

PRODUCT APPLICATIONS

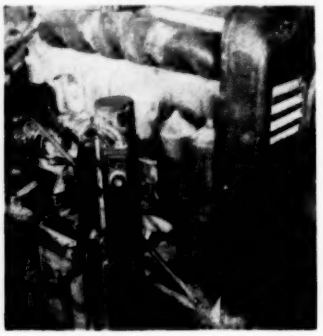
New, Unusual, or Ingenious Uses of Equipment and Materials

Conducted by WM. B. FOXHALL, Associate Editor

Electric Heaters Keep Diesels Running

PROBLEM: Diesel engines used in outdoor cranes, switch engines, trucks and other equipment are frequently difficult to start up on cold winter mornings. Cold engines must be idled for a period to allow lubrication to flow freely.

SOLUTION: Three cranes and a switching engine at Buffalo Slag Company, Lackawanna, N. Y., are heated with Chromalox electric circulation heaters. These heaters are attached to engine blocks with angle iron. Connections are made to cooling systems, and antifreeze is circulated by natural convection through the heaters and engine blocks. Electric heaters are a product of Edwin L. Wiegand Co. of Pittsburgh.



RESULTS: On average winter mornings, a 150F setting is sufficient to heat most engines in a half hour. In colder weather the heaters may be run all night at 90F. Time originally lost by equipment and personnel waiting for engines to warm up is saved.

Air Coolers Increase Business

PROBLEM: At the Eaton Manor Restaurant in Hamilton, Ohio, summer business was adequate but not up to what owner Walter P. Eaton, believed possible.

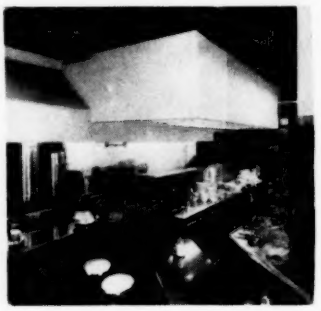
SOLUTION: In 1948, two Frigidaire 3-ton package conditioners were installed, one at each end of the sandwich shop annex.

RESULTS: At the end of a test period, it was found that the volume of business in this single dining room had increased by 100%. Having proved the advantages of air conditioning in the annex, Mr. Eaton equipped the main dining and banquet rooms in the older part of the structure with Frigidaire self-contained air conditioning. An increase of 85% in business of the first and second floor dining rooms was reported. Installation of self-contained units was accomplished without building alterations and without interruption of business. The nature of equipment provides effective zoning without extensive duct work.

Air Conditioner Uses No Floor Space

PROBLEM: At the Lewis Pharmacy in New York, floor space was limited and there was no room for installation of air conditioning equipment.

SOLUTION: Self-contained central station air conditioning equipment was suspended from the ceiling in an enclosed steel framework above and behind the counter, an installation engineered by Imperial Equipment Corp. The system utilizes a U. S. Air Conditioning Corp. 15-ton Kooler-aire unit which contains, in a single casing, all of the elements in a central plant including built-in evaporative condenser. The unit was placed in the open steel framework which was then enclosed in wire lath and plaster. The enclosure acts as a plenum for fresh air and evaporative condenser air which is taken from the outside wall of the building through a large duct. Conditioned air is distributed through a conventional concealed duct system.



RESULTS: All floor area is available for revenue producing use. The owner expects to pay the cost of construction of the enclosure through increased business at tables occupying the space which would ordinarily be devoted to air conditioning equipment.

Vermiculite Prevents Scorched Bread

PROBLEM: At the Canadian plant of Weston Bakeries Ltd., as with other commercial bakeries, the problem of scorched bread occurs when the conveyor must be stopped to change the variety of bread to be baked, or when the mechanism is adjusted. During these interruptions, excess heat builds up in the oven because there is no dough to absorb it. Unless a heat absorber is provided, the first row of loaves to enter the over after a shutdown may become so burned that they must be thrown away.

SOLUTION: The bakery first tried to solve the problem by filling the front row tins with water. These absorbed the heat, but scalding water sloshing around when the tins emerged from the oven was a hazard to employees. Water-soaked asbestos was then tried but was rejected because it turned black and slimy. Vermiculite, a granular insulating material mined by the Zonolite Co., was placed in the front row of bread tins and soaked with water.

RESULTS: The soaked Vermiculite absorbed the excess heat effectively, retained the water, and did not become unpleasantly colored. The bakery keeps a supply of bread tins containing Vermiculite saturated with water. When the production line is stopped, ten of these tins precede the next batch of bread going into the oven.

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Take a tip from Mr. Harden's experience . . . keep out of trouble with copper.

Now with restrictions eased, and quantities permissible without allotments greatly increased, there isn't any reason why you can't use Revere Copper Water Tube for radiant panel heating, hot and cold water lines, underground service lines, processing lines, and waste stack and vent lines. See the Revere Distributor nearest you today. And, if you have technical problems, he will put you in touch with Revere's Technical Advisory Service.

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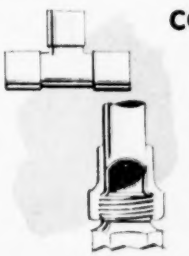
Save Fittings . . . Labor

Revere Copper Water Tube comes in straight lengths of 20′ in hard and soft tempers. 60′ coils of soft temper reduce the number of fittings needed.

SOLDER OR COMPRESSION FITTINGS
Need Less Work Room . . . Save Metal



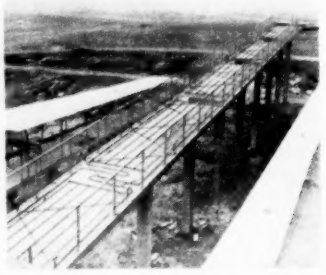
No worry about wrench room when you use Revere Copper Water Tube with solder fittings. Compression fittings can also be used. No threading is necessary with either type fitting. Wall thickness of tube used can thus be less than for threaded pipe.

NON-RUSTING

Rustable pipe eventually clogs as shown in drawing at top right. Non-rustable Revere Copper Water Tube suffers no loss of flow or pressure as shown at bottom right. No allowance in pipe size need be made for rust accumulation with Revere Copper Water Tube.

Air Terminal Features Snow Melting

PROBLEM: At the new Terminal Building now under construction at Philadelphia's International Airport, it was decided to provide an outdoor ramp leading to the observation deck and to provide loading piers or fingers extended from the main building so that passengers could enter and leave the planes without stepping outside.

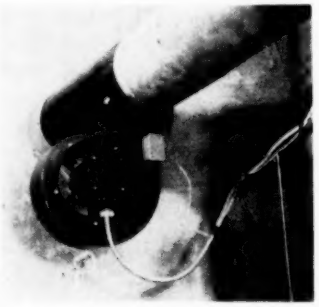


SOLUTION: The outdoor ramp leading to the observation deck has a built-in snow melting system of embedded wrought iron pipes, product of A. M. Byers Co. A heated solution of water and antifreeze is pumped through the pipes. A radiant heating system covering more than one half of the area of floor space is included in plans for the building.

RESULTS: The 10% slope of the ramp will be kept free of the hazards of snow and ice. Wide areas of floor space typical of terminal buildings will be evenly heated without convection drafts.

Industrial Furnaces Vented Horizontally

PROBLEM: When the P. Lorillard tobacco company transferred operations from a 5-story plant in Middletown, Ohio, to a new plant in another city, the old plant was purchased by a group of local industries who agreed to lease the building for five years at a rate that would permit eventual transfer to a fund held in trust for the benefit of the people of Middletown. Areas of the building were sublet to two tenants, one for manufacturing and the other for storage and warehousing. Terms of the lease would not permit continued use of the old central steam plant for heating the building. The plant had been designed for particular requirements of a tobacco manufacturer with the result that certain areas were overheated while others were lacking in heating facilities. The net cost of replacing the steam plant would have exceeded the cost of the building. The prospective tenants required temperatures of 72F for manufacturing areas and 55F for storage areas.



SOLUTION: The idea of replacing the heating system with furnaces located throughout the building at various locations was advanced. George L. Beckett, a local heating contractor, called upon engineers of the Farquhar Furnace Co. who prepared a layout and wrote specifications calling for installation of 29 furnaces. Problem of venting the furnaces was complicated by the Ohio code which calls for masonry chimneys, although a Middletown ordinance permits insulated steel chimneys. At this point, the Quickdraft Company was called in to see if their draft creator could provide sufficient draft to vent the furnaces out through the side of the building. On being assured that the draft would be sufficient, the layout was completed and approved by the Building Commissioner of Middletown with the provision that draft must be established before the furnace fire came on. The Quickdraft blowers were therefore arranged to be started by a room thermostat, and a sail switch operated by the blower was used to control the fire. Heater rooms with fire resistant doors were built for each furnace. Horizontal vents, each with a Quickdraft blower, were arranged to take out exhaust through the wall in the building. For the basement and lower floors, vents are run up the side of the building through vertical galvanized pipes to 15 ft high.

RESULTS: Building management was pleased at the rapidity at which the conversion was made. Indications are that fuel costs for an entire winter will be well below $10,000 against a previous fuel bill of $60,000. Cost of the new installation will be offset in less than two years by savings in fuel and personnel alone. Tenants are able to maintain temperatures in 29 different zones. Ventilation of the structure is improved by forced draft ventilation.

Packaged Boilers Serve Indochina Plant

PROBLEM: A new tire retreading plant serving the Vietnam forces in Indochina required steam capacity for about 4,500 retreads a month.

SOLUTION: Two 20 hp Orr & Sembower Powermaster automatic packaged boilers fired with light No. 3 oil were installed by Landis Brothers & Co. The boilers operate at 100 psi and are equipped with integral boiler feed systems and combustion air supply equipment designed to operate at 3,300 ft above sea level.

RESULTS: New plant operates on a 24 hour schedule and is considered a strategic addition to Vietman's security. Retreading is a great deal less expensive than the price of new tires.

Crane Cab Cooled

PROBLEM: In the Cleveland Works of Jones & Laughlin Steel Corp., the crane cab temperature in summer ran as high as 150F, making the cab intolerable for certain periods of very warm days.

SOLUTION: A Model C-5-SP crane cab cooler, product of Dravo Corp., was installed. This cooler is a split type unit used because of limited space available on the overhead bridge. The condensing and filtering section is separately mounted on the bridge and the evaporator is located inside the cab and is connected by a flexible pipe.

RESULTS: The cab temperature has been reduced from 150F to 80 or 85F in the summer months. The conditioner not only filters the air but reduces fumes and odors without requiring bulky duct systems.

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Ideal for heating large open spaces in industrial, commercial and educational buildings, standard Dravo *Counterflo* Space Heaters have five exclusive advantages over other warm-air space heaters.

1 The Dravo *Counterflo* combustion method takes place in a stainless steel combustion chamber. The exhaust gases from combustion are "whirl-cooled" through two sets of economizer tubes. This four-pass heat transfer results in a minimum heating efficiency of 80%.

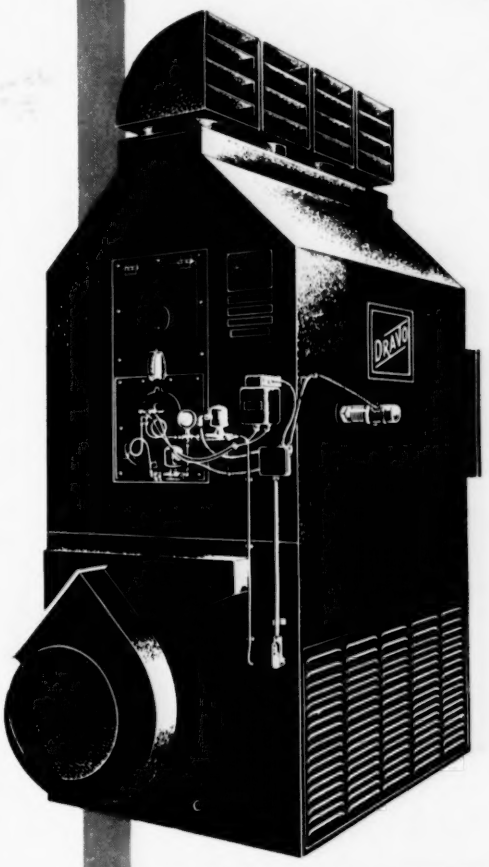
2 One rotor shaft operates all heater fans, thus co-ordinating exhaust, air-intake and heat-discharge systems.

3 Air for combustion is provided by main supply fan; volume and velocity are controlled by an adjustable damper.

4 Approved by American Gas Association and listed by Underwriters' Laboratories, Inc.; Dravo Safety Control Circuit is accepted by Factory Mutual Engineering Division.

5 Burners are designed by Dravo Engineers for top efficiency. Heaters burn gas or oil; burners are interchangeable to take advantage of fuel savings by using the most economical source of supply or in times of shortage the most available fuel.

Dravo *Counterflo* Space Heaters in addition to comfort heating are easily adapted to heat curing and process drying, tempering of replacement air and summertime ventilation. Dravo Heaters can also be tied in with air conditioning systems by making use of the same ductwork.



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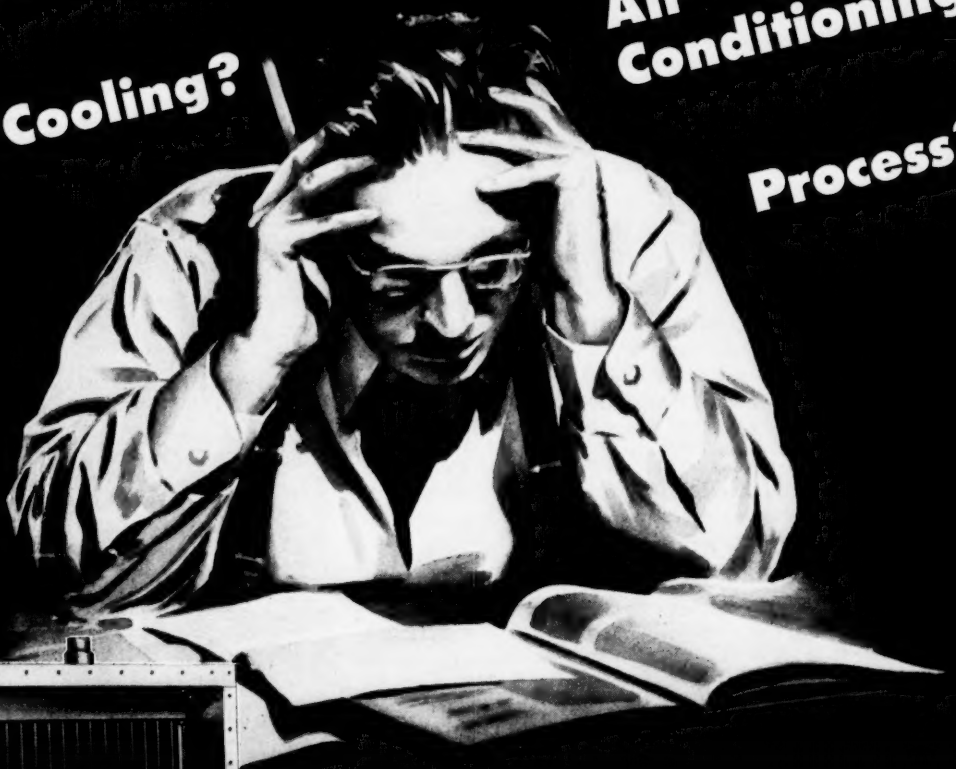
Process?



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NEW CATALOGS

TEST OF INSULATED PIPE

A 6-page report on simulated operating tests made on its line of insulated pipe is issued by Durant Insulated Pipe Co., Palo Alto, Calif. The bulletin contains details on methods, temperature recordings, and results of recent tests made by an independent engineering firm to determine (1) temperatures developed in and near pipe conduit buried 48 inches underground, and (2) effects of water and high temperature on pipe casing. ..... **Item 50**

ELECTRIC HOME HEATING

Form EC-140, discussing complete or auxiliary electric home heating, is issued by Electromode Corp., Rochester, N. Y. This 4-page folder contains illustrations and complete specifications for wall-type and portable all-electric heaters in all designs and capacities. ..... **Item 51**

FIBER GLASS INSULATION

General information and technical data about the use of fiber glass in the insulation of metal air ducts is provided in a 4-page folder titled, Insulation—Metal Air Ducts, which is issued by Fiber Glass Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio. The folder includes specifications for Superfine fiber glass drawings showing methods of installation and application of the blanket form fiber glass, tables providing sound absorption data, graphic curves dealing with thermal conductivity coefficients, and a list of sales offices..... **Item 52**

STEEL BOLTING PRINCIPLES

Bulletin 524, covering modern steel bolting for piping and pressure vessels, is released by Taylor Forge and Pipe Works, Inc., Chicago, Ill. First presented as a paper before an ASME Petroleum Division Conference, this bulletin is available to anyone interested in the proper selection of bolting materials. Comments on each ASTM specification are given in addition to tables on the compilation of properties and bolting selection. Also included is a discussion on the behavior of bolted flanged connections of the types used in piping and pressure vessels. ..... **Item 53**

PACKAGED FAN EQUIPMENT

Catalog No. 515, illustrating and describing a new line of Ready Unit V-belt driven, packaged fan equipment, is issued by Clarage Fan Co., Kalamazoo, Mich. Features are summarized, and complete capacities are given on each size of unit. ..... **Item 54**

AIRFOIL CENTRIFUGAL FANS

An eight-page booklet, Catalog 1320, on airfoil centrifugal fans, fans with airfoil shape blades, is available from Air Conditioning Div., Westinghouse Electric Corp., Boston, Mass. Airfoil centrifugal fans are designed for mechanical draft, high velocity air conditioning systems, heavy duty industrial applications and vehicular tunnel application. A graph of the certified horsepower, efficiency, and pressure ratings of the fans is presented, and the design features which contribute to these ratings are discussed. Brief descriptions of each of the five classes of fans available give maximum wheel speeds, total pressures, and volume ranges for each class. Construction features of housings, wheels and shafts, and bearings of heavy duty airfoil fans are discussed with emphasis on the special manufacturing processes involved in their fabrication. The booklet also includes a section on the optional inlet vane control. ..... **Item 55**

INDUSTRIAL CONTROL CATALOG

Complete information on its industrial controls is now available in catalog F 3941-2 issued by Barber-Colman Co., Rockford, Ill. The 32-page booklet covers control terminology, thermostats, proportioning pressure switch, humidity controls, types of valve bodies, motor-operated valves, solenoid valves, valve capacities, temperature regulators, control motors, relays, electrical accessories, and heating and air conditioning controls. Many tables, diagrams, and illustrations are included..... **Item 56**

INDUCED DRAFT BIFURCATOR FANS

Bulletin DB-32-52, covering its line of induced draft bifurcator fans which provide controlled draft for boilers and furnaces, is issued by DeBothezat Fans Div., American Machine and Metals, Inc., East Moline, Ill. The catalog contains illustrations, specifications and dimensions of fans in 24 sizes, for high pressure boilers delivering up to 60,000 pounds of steam per hour and for low pressure boilers rated up to 190,000 EDR. ..... **Item 57**

CONTINUOUS WELD PIPE

A folder, entitled The ABC of Yoloy Continuous Weld Pipe and Its Corrosion Resistance, is issued by the Youngstown Sheet and Tube Co., Youngstown, Ohio. The folder describes the composition, advantages, and applications of the pipe, explains its physical properties, and compares its chemical analysis and tensile strength with other types of pipe. Physical properties such as yield point and elongation are also listed and compared with other metals. Specifications of the pipe are included. ..... **Item 58**

VACUUM CLEANING SYSTEM

Bulletin D-5, a new 20-page, two-color booklet giving complete information on its Exidust central vacuum cleaning system, is distributed by Billmyre Blower Div., Lamson Corp., Syracuse, N. Y. Diagrams as well as photos are used to describe this industrial and commercial cleaning system which picks up dirt, dust and small particles by means of a flexible hose and attachments and passes them through a stationary piping system to one or more collector separator tanks. Following basic engineering information, the booklet describes uses and names representative users. Design features and details are presented. Sufficient engineering data are included in the bulletin to make it possible for the reader to plan his central vacuum system in detail. ..... **Item 59**

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RADIANT HOT WATER HEATING

An 8-page booklet, Form HV-53, presenting a basic discussion of radiant hot water heating is distributed by Weil-McLain Co., Michigan City, Ind. Three basic problems, how much heat is needed, how to assure comfort, and what is comfort engineering, are discussed briefly. Problems presented by poor heating, the major points of adequate comfort engineering, circulation, strategic placement, heating media, and insulation are also discussed. ..... **Item 60**

SOOT BLOWER INSTALLATIONS

Bulletin 1004, a 32-page booklet discussing 15 central station installations using its automatic-sequential soot blower systems, is released by Copes-Vulcan Div., Continental Foundry and Machine Co., Erie, Pa. Diagrams and specifications are given to show how the installation solved the particular problem. Power and reheat boilers with capacities to 1,370,000 per hour, pressure to 1925 psi, and temperatures to 1055F are included. Bdowing medium employed can be either steam or air, and the units are driven by air or electric motor. ..... **Item 61**

DIFFUSER SELECTION MANUAL

The new 64-page selection manual No. 45—1953, containing comprehensive technical data for simplifying choice of proper air diffusers in air conditioning systems, is announced by Anemostat Corp. of America, 10 E. 39th St., New York, N. Y. Now in its third revised edition, the Manual contains a complete new section on duct take-off design. Containing numerous photographs, tables on performance data, and case examples, the manual shows how proper locations and correct number of required units are determined. Requests for the manual should be addressed to the firm on your company letterhead. ..... **Item 62**

HIGH CAPACITY V-BELTS

High-capacity Texrope V-belts are described in bulletin 20B7786, which is released by Allis-Chalmers Mfg. Co., Milwaukee, Wis. According to the bulletin, the V-belts carry a high horsepower rating, are oil resistant, and are static conducting. Recommendations for use in various situations are included in the bulletin along with features and advantages. Diagrams showing applications of the V-belt are presented... **Item 63**

REFERENCE HANDBOOK ON HEATING

A 400-page desk reference, entitled Handbook on Heating, is published by C. A. Dunham Co., Chicago, Ill. Covering the selection, application, and installation features of baseboard, convector, and fin-vector radiation, vacuum and condensate pumps, unit heaters, steam heating specialties; and complete heating systems, this illustrated handbook is designed for use by architects, heating engineers, and as a basic school textbook. It is priced at $2.50.... **Item 64**

AUTOMATIC INDUSTRIAL BOILERS

A four-page, illustrated booklet describing its line of Continental automatic boilers is published by Boiler Engineering & Supply Co., Phoenixville, Pa. In addition to containing detailed engineering data and specifications, the booklet also discusses the features and advantages of these boilers. Boilers range in size from 20 to 500 hp, and each model has a guarantee of 80% efficiency. These boilers can be used wherever steam is required for applications other than power. The major uses are as heating units, and as a source of steam for process industries. ..... **Item 65**

MECHANICAL SEPARATOR CATALOG

A new 8-page folder entitled, End Dirt and Moisture Problems the Hi-eF Way, is published by The V. D. Anderson Co., Cleveland, Ohio. It describes the uses of purifiers or mechanical separators throughout the petroleum, chemical, and food industries as well as in all steam generation and distribution systems. This bulletin describes in detail how purifiers operate on live steam, exhaust steam, compressed air, vapor, and gas lines. Cutaway views showing the installation of purifiers in 14 different applications are accompanied by a brief description highlighting the purpose of the purifiers in each case. Information is also given on the types of entrainment likely to be found in the various vapors and gases. Photographs shows samples of condensed steam before and after a purifier is installed and accumulation of scale in a typical pipeline not equipped with a purifier. In addition, the bulletin lists the seven types of the firm's purifiers available. ..... **Item 66**

TEMPERATURE CONTROL MANUAL

Bulletin 101, a new edition of its manual, The Design and Process Engineer's Guide to Industrial Temperature Measurement and Control, is published by The Partlow Corp., New Hartford, N. Y. This revised 24-page two-color manual presents the basic principles of industrial temperature control in practical fashion. It defines different types of control systems and distinguishes between them so that the engineer can select the type most suited to a particular application. The manual discusses eight ways of responding to temperature, five ways of putting that response to work, and nine basic instrument types. It then takes up evaluation of systems and the important considerations in application engineering. Discussed in the booklet are the influence of the firing system upon design of the control system, fundamental principles of mercury-bulb installation, and basic concepts of electrical and mechanical control. Typical control circuits and piping system arrangements, as well as the ranges and calibrations of scales and dials, are presented. ..... **Item 67**

AXIAL FLOW PUMPS

Catalog A-53, a 12-page bulletin covering its new line of Rapidayton axial flow pumps of ⅓ to 2 hp rating, is published by Dayton Pump and Mfg. Co., Dayton, Ohio. A cross-section diagram shows the construction of the pump, and the accompanying text describes its features. Tables and diagrams show the capacity, specifications, and uses of the pump. The pump, which is of the jet-centrifugal type, is described as available in single or multi-stage models for deep and shallow wells. ..... **Item 68**

ADJUSTABLE STEEL FRAMING

A fully illustrated, 44-page engineering catalog on its all-steel adjustable framing is issued by Flexa Steel Products, Inc., Chicago, Ill. Called Catalog No. 153, the new brochure gives initial basic information on channels and fittings, including dimensioned drawings and engineering data. ..... **Item 69**

COMPLETE VALVE LINE

A new 24-page catalog, NVC-1, on its complete line of valves, is published by Northern Indiana Brass Co., Elkhart, Ind. The catalog describes threaded, solder end, and flared tube valves, listing 44 different styles of valves in angle, gate, globe, and swing check patterns. It also introduces a new line of 125 lb SWP gate valves of non-rising stem, wedge-disc construction.. **Item 70**

GAS WATER HEATERS AND BOILERS

A new catalog containing specification sheets on its line of automatic gas water heaters and heating boilers, is released by Ruud Mfg. Co., Pittsburgh, Pa. Illustrated and described in the catalog are Monel series automatic storage water heaters, gas fired boilers, parallel flow water heaters, continuous flow water heaters, Sanimaster 60 water heaters or boosters, two-temperature storage water heaters, continuous flow instantaneous water heaters, multi-coil water heaters, a hot water system for commercial dish-washing, and a hot water sanitizing system. Each sheet gives specifications and capacities for the unit, diagrams the construction, and shows its installation and advantage..... **Item 71**

DEWPOINT MEASURING EQUIPMENT

A new 8-page bulletin, GEC-588A, on dewpoint measuring equipment for continuous indication and recording of dewpoint temperature in a gas stream, is published by General Electric Co., Schenectady, N. Y. The booklet contains photographs and diagrams of the dewpoint indicator and recorder; gives applications, descriptions, and operation principles; and provides a chart showing the relation between dewpoint and moisture content of gases..... **Item 72**

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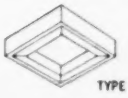

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By T. W. REYNOLDS

• PARALLEL OPERATION

Occasionally the question arises as to when are fans being operated in parallel. The more usual parallel operation is generally recognized, that is, one where identical fans operate with identical speeds and pressures on a common system.

However, fans when connected to a common system operate in parallel, whether the fans are identical or otherwise either as to size, design, speed or capacity. It does not matter whether the fans are used as supply, exhaust or booster fans or if they are two or more in number. Furthermore, the fans can be so arranged that each develops a common pressure and encounters a common resistance on both supply and discharge sides, or the system may be common only to either the inlet or discharge side of the fans.

Fans which operate in parallel must be properly selected for such operation or they will not operate as desired or as indicated in the manufacturer's catalog. Capacity may become insufficient, noise excessive, and motors overloaded.

• HEAT LOSSES OF SWIMMING POOLS

A correspondent writing from Oklahoma wants data on how to calculate the heat loss from the water to the walls of a swimming pool constructed of 4-inch concrete on dirt. The pool is 30 ft long by 12 ft wide with an average depth of 5 ft. The room and water are to be maintained at 90F.

The query is interesting because the wall does not have air on each side of it, but ground on one side and water on the other side, a condition of heat transfer for which there is not too much data. However, the most interesting (although natural) thing about the query is its failure to inquire about the evaporation loss which is of much greater moment than any wall to ground loss.

This loss can vary a lot according to the room and water temperatures, the humidity of the room, and the air movement over the surface of the water, although the main variant is that due to the air movement. Another factor is the distance from top of the pool to water level, since the greater this distance becomes, the less there will be of air movement over the surface of the water. As the air movement decreases, a blanket of saturated air builds up in the pocket so formed to hold down the evaporation rate of the water.

The loss from the water to the ground will not be high because the ground is to some degree an insulator due to its great thickness. There is no air movement on either side of the wall and the water movement on the pool side can never be anywhere near as great as that of still air which is from 15 to 25 fpm.

Heat losses to ground also depend upon the condition of the soil as to kind, density, presence of moisture and whether or not frozen. Moisture will increase with heavy rain, snowfalls, and snow remaining long on the ground. Nevertheless, in New York State the ground temperature would usually be assumed as high as 50F for a room temperature of 70F, but for 90F the ground temperature could be safely taken as 60F. On top of this the pool, compared to an installation in New York, is located where the ground water temperature is 15F higher, the average winter temperature much higher, and the number of degree days of heating about one third less.

In reality one can be a bit careless about the precise ground temperature selected since it is customary to use only 0.10 Btu (sq ft) (hr) per degree of temperature difference as the heat loss for walls next to ground. This is so small that any reasonable assumed ground temperature will not materially affect the calculated heat loss. Of course, the heat loss will be considerably increased if the pool is too close to exposed building walls, particularly when near a northerly building wall.

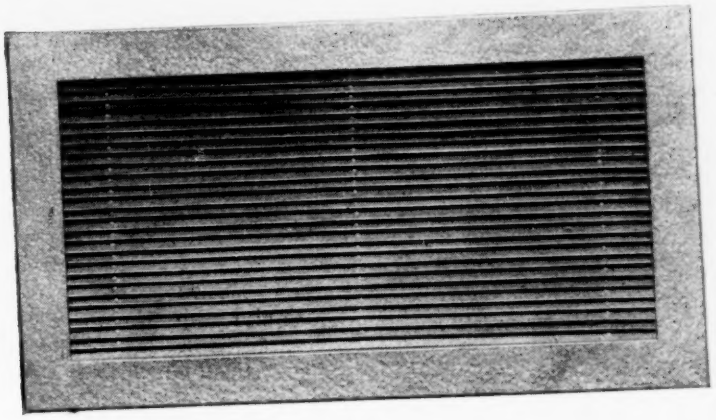
Water evaporated from a pool adds to the heat of the room if condensed on its walls and glass. If the room is relatively small, the humidity may build up to where ventilation will be required to remove vapors. This tends to increase the rate of air movement over the water and requires additional heat for raising the temperature of make-up air from outdoors. Another source of heat loss is in the water splashed or trailed over to scum gutters by bathers, such water being discharged to the sewer.

With water at 90F and the ground at 60F, the pool will lose 3 Btu per hour per square foot of wall and bottom surface, or a total of 2,340 Btu. This amount of heat loss is of no moment from the standpoint of boiler load, fuel economy, or the initial warming up load. The water in the pool weighs 112,500 lb and it will lose as many heat units in an hour to cool but one degree, hence, the pool would cool only one degree in 48 hours, provided heat lost through wall and bottom surfaces were the only heat loss.

The loss from the surface of the water in heat units per hour will vary according to the following assumptions. For a still air movement of 25 fpm and relative humidities in the room of 50%, 40% and 30%, the heat losses in the same order will be 30,348, 32,940 and 39,048 Btu. For a still air movement of 15 fpm the heat losses will be 31,644 and 36,936 Btu with relative humidities in the room of 40% and 30%, respectively.

I would select an air movement over the surface of the water of 25 fpm and a relative humidity of 40% for a room reasonably ventilated. If this loss is added to the loss of the ground the pool water will be lowered one degree in about 2 hours.

(*Continued on page* 150)



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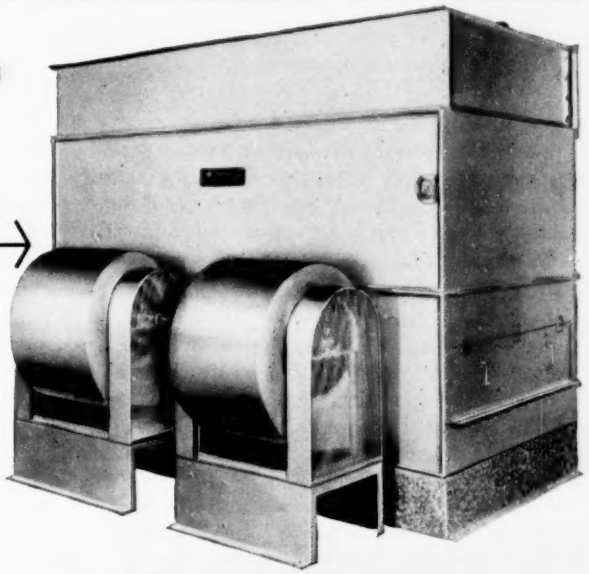

Binks Series "B" Mechanical Draft Towers are establishing new performance standards for NOISE-FREE operation because they employ squirrel-cage blowers operating at slow speeds. Their design also provides much simpler maintenance because the operating parts are located in the DRY AIR stream—never come in contact with corrosive, moist exhaust air.

Available in capacities from 1 to 108 tons, Binks Series "B" Towers are ideal where quiet operation is essential—for example, hospitals, hotels, apartment buildings, private homes, commercial establishments, etc.

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(*Continued from page* 148)

As an example of the evaporation loss, assume 40% RH which at 90F has a dew point of 62.5 and a partial vapor pressure P of 0.57 in inch Hg, the air movement V being 25 fpm. The latent heat L of the water at its temperature of 90F is 1042.4 and its saturation pressure P_s is then 1.422. Then the heat lost Q from the entire water surface in Btu per hr is

$$Q = 0.093L\left(1 + \frac{V}{230}\right)\left(P_s - P\right) \times \text{sq ft of area, or}$$

$$0.093 \times 1042.4\left(1 + \frac{25}{230}\right)\left(1.422 - 0.57\right) 360 = 32{,}940 \text{ Btu per hr}$$

• MUSHROOMS MUST BE COMFORTABLE

When a boy in the country, field mushrooms pushed up under the bare foot, even though right out in the unprotected open. They did not do this often because nature could not do for them what air conditioning can do. On the other hand what air conditioning can do to a mushroom when the air distribution is poorly designed, installed or balanced is yet another thing.

Which brings up the thought that comfort air conditioning and process air conditioning are such different things. Although causes may be alike, effects can be so unlike. For example, those who upon occasion complain of uncomfortable drafty conditions in air conditioned spaces are not always believed. We still look the same to others and no different than those who offer no objections regarding air movement.

Now put some articles of food, mushrooms, for example, in that same objected to space and note what happens. The common denominator mushroom then takes on personality and no longer looks the same. Certain ones scale, discolor, dry up quickly and require more watering. Others reach a good growth and quickly so—no troubles at all.

What is causing all this? Is it improper temperature or humidity at which the space is held? No, it is more simple than that. It is just the unequal air movement throughout the space, a thing easily intensified by the rows and stacks of mushroom beds.

Take an actual case as shown in Fig. 1. In this installation the air diffusers, only three in number, were supplied with 35% less air than computed while the vertical distance from the bottom of the diffusers to the top tiers was 24 inches instead of 36 inches. Diffusers were installed without any blank off baffles where required and with equalizing damper blades in other than 90 degree setting to air flow, thus causing a one-sided air discharge. Therefore, although, air motion varied from 30 to 50 fpm, even to 100 fpm near the diffusers, no balancing of air delivery had been attempted.

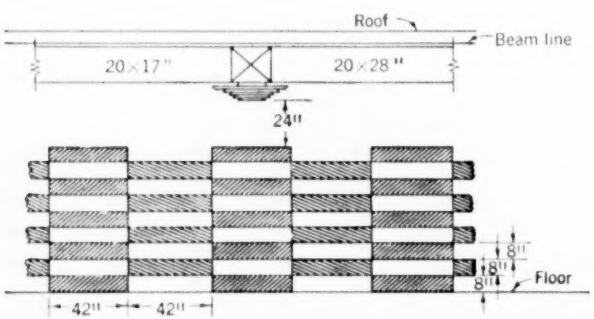

Fig. 1. Stacking of mushroom beds.

So the mushrooms in the upper tiers took to scaling, dried up unless wetted twice as often as others, and growth was retarded. Air was also projected in a drafty way down along the outer walls. The horizontal distance of 23 inches from wall to nearest row should have been 30 inches minimum.

• SINGLE GLASS FOR LARGE WINDOWS

One recalls the picture or large area window and how thermal losses from this large glass area would be more than offset by double glazing. What happened? Cost of double glazing went up and as a consequence so did single glass. However, the wider use of double glass only got into the original picture partly on the basis of a fuel saving program. The double glazing was referred to as insulating glass, and rightly so, but unfortunately we have wound up with too much single glass as a substitute.

It can be argued (1) that the cost for additional fuel (because of single glass of large areas) will be largely offset by the saving in the first cost of single glass, (2) that each square foot of single glass eliminates the thermal loss and the cost of wall construction and of insulation, if any, from an equal wall area, (3) that a large window area provides less crackage for air infiltration per square foot of window area than multiple small windows totaling less area, and (4) that the larger the window, the greater the saving on lighting bills.

As against all this, the writer offers the thought that (1) higher temperatures will have to be carried for equal comfort, (2) that boiler and radiation will have to be increased in capacity, (3) that the cost of fuel has gone up as well as that for glass, and (4) that the saving in first cost by using single glass occurs but once only, whereas the cost of fuel goes on for years and fuel cost will ever be higher.

• DON'T RELY TOO MUCH ON RELIEF

There is a wasp in Florida and certain other southern states that goes around plugging any hole to ¼ or ⅜ inch in size with cocoons. It matters not whether its a hole for a vent or pressure relief, or just one for the placement of a screw to hold hurricane shutters. To him it is just a good opening to plug with cocoons and finish off with a cement so hard it takes an awl for relief.

Nature is lavish in tropical climes—more wasps than holes. Wasps, looking for new outlets, went to work on the small relief pipe from my hot water heater and closed its outlet outdoors. Then finding it to be an unusually deep hole, continued on for 6 ft within the pipe until an awl was no longer effective for all of the pipe. So a long and firm wire with small hooked end had to be patiently used for a couple of hours.

(*Continued on page* 152)

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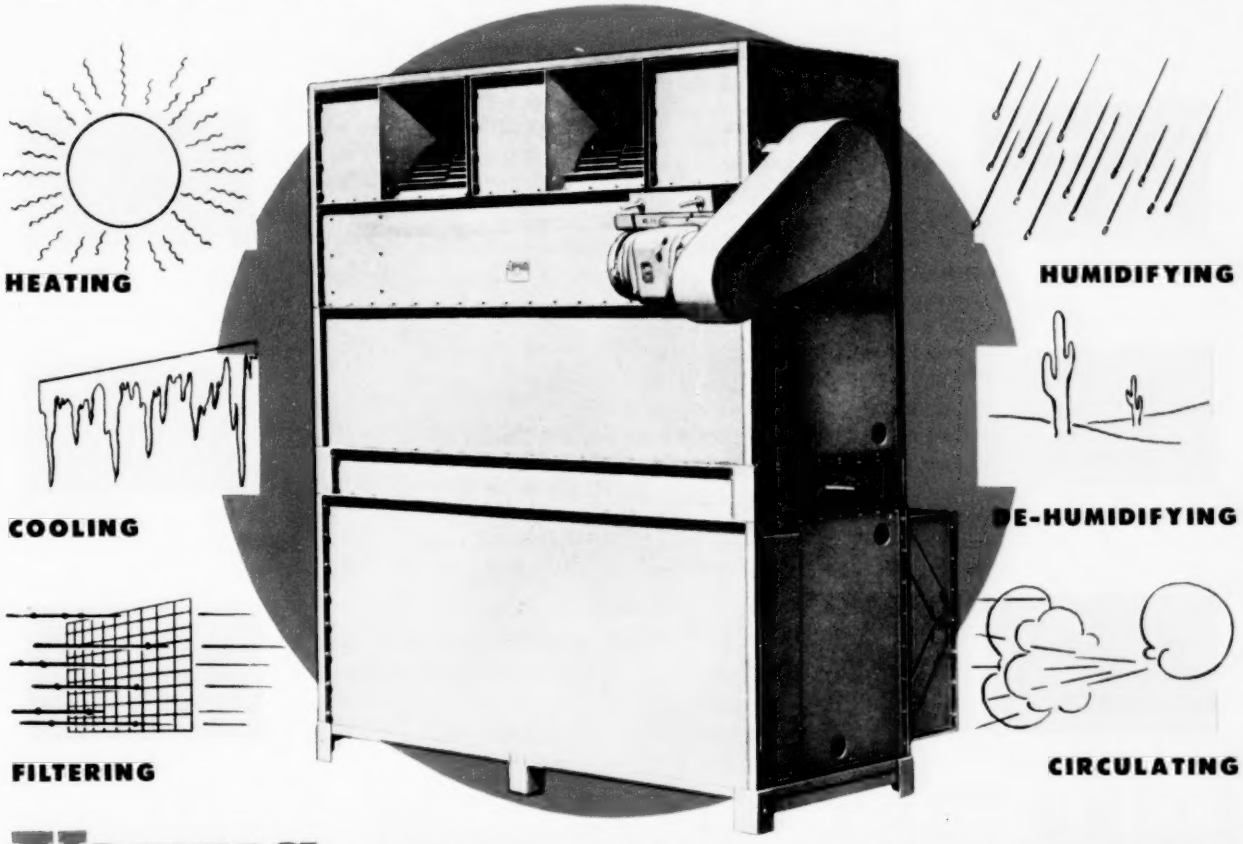

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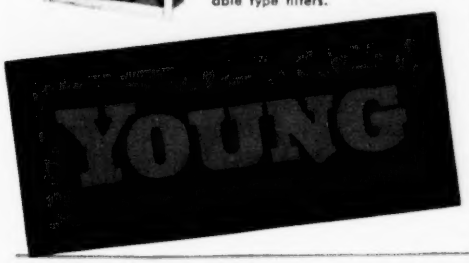
Young sectional design air conditioning units enable you to offer year-around comfort. To meet specific requirements, "YAC" units are available in any combination from simple heating or cooling to complete air conditioning, including heating, humidifying, cooling, dehumidifying, filtering and circulating. "YAC" units are built in eight compact sizes, in either horizontal or vertical types, in capacities from 400 to 15,748 cfm. They can be installed either right or left hand. Young sectional design also permits greater ease in handling, installing and servicing. For further details or Catalog, see your nearest Young sales representative or write direct.



...AN "OLD" NAME IN HEAT TRANSFER ENGINEERING

YOUNG RADIATOR COMPANY

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Sales and Engineering Offices in All Principal Cities

(*Continued from page 150*)

Discovery of this particular closure was brought about due to excess water pressure. Neighboring relief valves spilled water as evidenced by flow down paved streets. Water is expensive, electrically heated more so, and continued overnight relief adds up the evil. So while nearly everyone was troubled about the awful waste going on before their very eyes, the writer was bothered not because his relief pipe was ejecting water, but rather because it was not. Some solace, however, was temporarily obtained by discovery of a second relief valve down the street which also did not waste water. Such solace was short lived for the owner said he was too smart for the water utility and some time back had put a stop valve in the relief pipe.

In the case of one dwelling, the investigation of excess water pressure disclosed a relief pipe outlet that discharged water both night and day continuously, regardless of the utility water pressure, a fact not noticed before due to coverage of outlet by a hibiscus bush. In this case spillage was due to overheated water, low relief setting, or a relief valve stuck in the near-open position. This proves that a relief outlet should be visible, such as the one in the garage of another dwelling nearby where the relief valve has no relief pipe and merely discharges on the floor.

Insurance underwriters have long realized the need for frequent inspection, manual operation of pressure relief valves, and connecting relief pipes. Their records cover explosions in tanks for blowoff, blowdown and condensate return, and in equipment for cooking and process in brewery, chemical, packing and other plants.

A vent for pressure relief acts as a safety valve only so long as it remains wide open. But time passes and what happens. Relief pipes are then found partially or entirely closed due to freezing of vapors at open end or pocketed water elsewhere. Scale or grease accumulates, a river at flood tide backs up mud into a relief pipe on the river bank, a rodent goes in the pipe and dies, the birds start a nest therein, or someone valves or plugs its end. At other times its just the boys having a game of who can toss a stone from a nearby hillock to the open end of a safety valve pipe on a one story roof.

What ever it is, it is bad, and it is bad from the very start if the resistance of the pipe is too great because of long run, numerous fittings, insufficient size, or choked area. Horizontal pipe runs tend to sag and collect things; water pockets cause water hammer with possible destruction of the pipe itself and all of this is worse the smaller the pipe size selected.

Aside from increase in pipe size, there are various other remedies for the troubles cited. One remedy is inspection. It is likely to be more frequent if the relief valve has an outlet not only visible and accessible, but most noticeable. A directional sign is helpful, but visibility is the most important thing. For example, some remote safety valve may pop open and not close until the boiler water has blown away as steam.

Each safety or relief valve should have a test lever, conveniently located if possible, and where it is not too hot or dirty for reasonable access. A second relief valve with open end inside the structure and set for a slightly higher relief is advisable. Incidentally, one may be led to believe that a relief pipe is of adequate size because with manual test it may pass the steam or water as required, but it should be remembered that with automatic operation the valve will pass much more steam. Another point to remember is that pressure on dead end service can build up with a pressure reducing valve when single seated, if eroded, just as much or possibly more so than with a valve of double seat.

Some desirable things in connection with relief are no stop valves, pipe of non-rusting metal with end protected by a well-secured non-rusting screen of much greater net area than pipe outlet, and an umbrella fitting or expansion joint at the junction of steam relief valve and pipe. The relief outlet should be where its discharge is not likely to harm workmen or a rambling child. In one instance a relief pipe was run to and in a pipe tunnel to river, but in time it only ran to the tunnel since the part within the tunnel rusted away.

Throughout the years I have proposed some funny ideas to others only to come across the suggested product or patented idea some years later. With this in mind, I would say there may be some possibilities with an unorthodox relief pipe of rubber which could slightly expand to provide additional area for flow as well as for release of plugged debris. Such a pipe could be run inside of a much larger metal pipe.

I would like to give passing mention to a relief pipe which gave a warning whistle when in use. It gave the most relief when it and its whistle made a quick exit one day along with steam and was never seen again.

• PIPES FOR VISUAL AND EASY FLOW

The field for glass or plastic pipe is becoming widened as these products are improved for better application. A glass pipe is certainly a help in locating stoppages. What a help it could be if used at lavatories in hotels just for locating lost jewelry. At present, however, glass pipe use is mainly confined to laboratories and the pharmaceutical industry.

Glass pipe has been developed to better withstand sudden changes in temperature as well as for operating pressures of from 20 to 50 psi. The pressure limitation depending upon pipe sizes of 6-inch to 1-inch, respectively. Glass pipe is corrosion proof, therefore contains no rust discolorations or pitting to build up deposits. The pipe is light, and smooth for easy flow, cleaning and sterilizing. It can not contaminate products.

Glass pipe is much used where visual inspection of fluid flow is required, especially where any color change in fluid must be quickly detected, or where drainage and cleaning of pipe interiors must be thorough. What a help it could be for drainage of air conditioning coils to insure against freezing.

As for plastic pipe, it is now widely used in the chemical and petroleum industry, especially so due to shortages of metal pipes. Plastic pipe begins to soften at about 210F, hence the manufacturers do not recommend it for conveying hot water. The pipe is light in weight, corrosion resistant, has a low friction loss and is flexible for ease of installation and adjustment to turns or contours. Resinous substances do not adhere to its inner walls and thereby cut down the flow. This kind of pipe might be the answer to locations where copper or brass pipes are frequently stolen for their junk value.

Darling it's so exciting . . .

I just can't wait

to see those sensational, new

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Perimeter Baseboard Registers

WITH SLIDING DAMPER CONTROL

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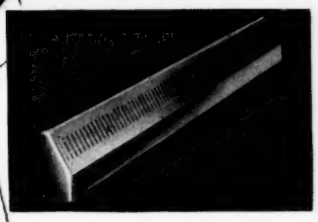

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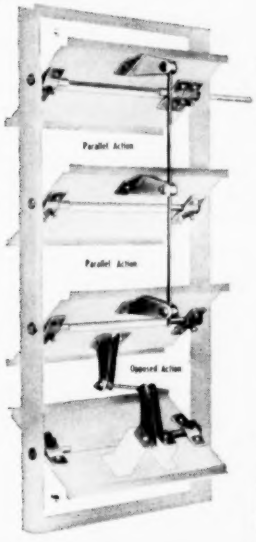

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(Parallel or Opposed Action)

Specify and use the . . .

"DURO BLADE KIT"

PRECISION-ENGINEERED DAMPER HARDWARE

- Produces highest quality damper
- Blade openings individually adjustable. Automatic, self-centering DURO-BRACKET assures smooth, non-binding, quiet operation. Self-oiling DURO-BUSHINGS "tap-fit" into frame.
- Complete adjustability, even after installation, cuts time and cost. Allows use of unskilled labor.
- Sturdy, corrosion resistant materials used throughout. Can be used on heaviest dampers.

For Samples—Prices write **Dept. E**

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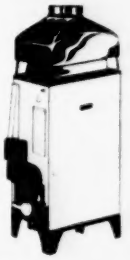
first for all 4

Specify
THE IMPROVED WATROLA "160"

HOT WATER BOILER for: *Radiant heating systems . . . convector heating systems . . . booster service* (180° sanitary water) . . . and *volume hot water heating* in hotels, restaurants, apartments, hospitals, self-service laundries, swimming pools, etc.

FEATURES INCLUDE: All-copper heat exchanger; extremely compact size (only 45½" high); patented safety controls. 160,000 B.t.u., A.G.A. approved for natural and manufactured gas; shipped complete, ready for installation. Send for descriptive literature, specifications.



SELECTED TERRITORIES STILL OPEN TO QUALIFIED DISTRIBUTORS

THE IMPROVED

Watrola "160"

HOT WATER BOILER

McIntyre Engineering Co., Inc. Watrola Division
South San Francisco, California

NEWS OF THE MONTH

EDUCATIONAL EXHIBIT

demonstrating reactions of humans to air conditioning was shown at Heating and Ventilating Exposition.

One of the feature exhibits at the recent 11th International Heating and Ventilating Exposition held in the International Amphitheatre, Chicago, Ill., was the ASHVE Educational Exhibit. From a prominent location in the center of the second floor of the South Wing of the Amphitheatre the Society displayed a dynamic cross-section of its current research activities with examples of projects being conducted in its own Research Laboratory in Cleveland, Ohio, and one set-up which illustrated the cooperative research work which it sponsors in universities. Enlarged photographs, charts, mock-ups, and full-scale models were used to portray many of the problems now under study.

● **SPONSORS**—One of the major components of the Society's exhibit was a full-scale demonstration of the physiologic adjustment of a clothed person to sudden changes in humidity and temperature. This demonstration, carried out by the Departments of Medicine and Mechanical Engineering of the University of Illinois was used as an illustration of cooperative research. It showed clearly one phase of a comprehensive research program having to do with man's response to his environment which has been in progress in the College of Medicine at the University of Illinois for the past eighteen years. This program is supported by the American Society of Heating and Ventilating Engineers, The United States Public Health Service, and the University. While, initially, the work was conducted with healthy male and female subjects between the ages of 18 and 26 years, it has been expanded to include certain physiologically impaired or sub-normal persons and persons advanced in age.

The physical facilities of the University's demonstration included two small 4 by 4 by 8 ft air conditioned rooms, each equipped with a complete system for controlling the humidity and temperature at preselected levels. Each room had two transparent walls and a transparent door. A number of companies and individuals cooperated by furnishing equipment and services. The Department of Mechanical Engineering built the exhibit and operated the physical facilities.

In one of the air conditioned rooms the conditions simulated those of a comfort air conditioned space; namely, 75F and 50% R.H.; while those in the second room, 100F and 60% R.H. simulated the conditions of a hot-humid street during the summer.

● **SHOCK**—Dressed in typical summer clothing, placed over special thermocouples located at strategic points on her skin, an attractive young girl, after sitting in the comfort air conditioned space for 10 minutes, moved rapidly into the hot-humid environment. After 10 minutes in the hot-humid environment where she became warm and began to perspire, the girl returned to the comfort air conditioned space for an additional ten minutes. This procedure exposed the girl to sudden changes in environment very similar to those experienced by the members of the general public as they go in and out of air conditioned homes and stores during the summer months.

Fast temperature indicator-recorders showed and recorded the changes in the temperature of the girl's body and skin at a number of points and medical doctors explained the significance of the changes. Six complete demonstrations were made each day.

Large scale charts mounted near the air conditioned rooms showed typical results of other environmental-physiological studies which are being made at the University in the general environmental research program.

(*Continued on page* 156)

Tohru Inouye, left, and Georgie Oehmke, both of University of Illinois, demonstrate reactions of model to summer air conditioning. Mannequin shows placement of thermocouples.

Robert W. Keeton, M.D., left, Nadia Karweke, and Professor M. K. Fahnestock

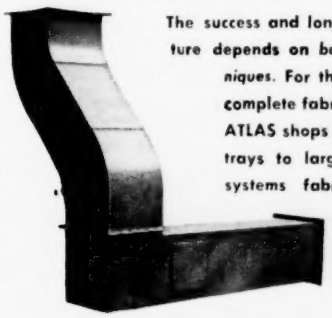
Economical protection that is built . . . NOT APPLIED

AMPCOFLEX® is an unplasticized, rigid polyvinyl chloride. It is corrosion-proof all the way through . . . and self-supporting as well. It has no coating to wear with time . . . nor edges or under-surfaces that ever become exposed and corrode. AMPCOFLEX Fabrications provide you with the long-term, economical solution to many industrial corrosion problems.

While only one-half the weight of aluminum, AMPCOFLEX has a tensile strength of 9000 psi at 75° F. It is inert to most acids, salts, alkalies and standard pickling and plating solutions.

One of the more important uses of AMPCOFLEX is for fume exhaust systems. Here, additional properties of impermeability, high dielectric strength and low fluid friction factor are definite advantages.

AMPCOFLEX . . . *plus ATLAS specialized experience and fabrication facilities*



The success and long life of a corrosion-proof structure depends on *both materials and construction techniques*. For this reason, ATLAS has developed complete fabrication facilities for AMPCOFLEX. ATLAS shops will produce any item from small trays to large tanks and complete exhaust systems fabricated of unplasticized, rigid polyvinyl AMPCOFLEX. In addition, ATLAS will furnish necessary pipe, pipe fittings and accessories.

For Complete Data, write for Bulletin 9-1.
ATLAS MINERAL PRODUCTS CO.
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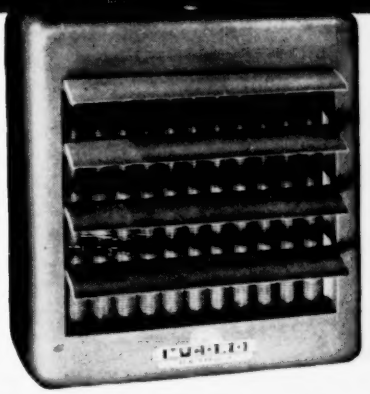
self-supporting, corrosion-proof structures

TEXAS Ampcoflex
FABRICATIONS

McCORD

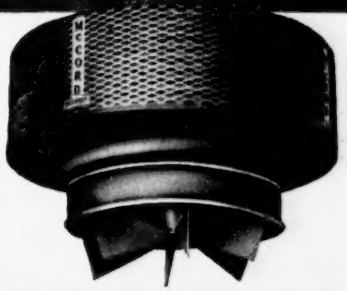
HEATING AND AIR CONDITIONING PRODUCTS

HORIZONTAL TYPE UNIT HEATERS



Modern design—top performance—thousands in use—dependable heat. All copper coils to resist corrosion — individual tube expansion — most rugged construction — quiet operation — easy installation—standard motors with standard bases. Sizes to 272,000 B.T.U. capacity.

VERTICAL TYPE UNIT HEATERS



A proven heating unit—all copper coils to resist corrosion. McCord spiral tube fin construction creates air turbulence without undue restriction. Improved fan delivers large volume of air, with minimum air noise. All McCord heaters are guaranteed for use with 150 lbs. saturated steam pressure. Sizes to 575,000 B.T.U. capacity.

McCORD CORPORATION
DETROIT 11, MICH.

NEW! HEAVY DUTY
CHELSEA FANS
POWER LINE
-for industrial applications
DIRECT DRIVE OR BELT DRIVE
NON-OVERLOADING PROPELLERS

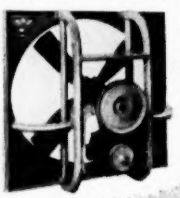
SOLVE YOUR VENTILATING PROBLEMS
with Chelsea's new heavy duty airfoil type exhaust fans. For use in exhausting, duct work, filter installations, range or vat hoods, penthouse units, paint spray booths, where static pressures are encountered.

WRITE FOR NEW CHELSEA CATALOG No. 400
including detailed information on type, size, specifications, engineering data and installation recommendations. 30 types and over 200 sizes. Please address requests to Dept. N-4.

FOR FACTORIES, FOUNDRIES, MINES, MILLS
—totally enclosed ball-bearing motors

● TYPE PLF POWER LINE DIRECT DRIVE — 16" to 48" in all H.P. ratings. Square frames for easy installation.

● TYPE PLDX POWER LINE DUCT BOOSTER—Motor external to Air Stream. 16" to 48" in all H.P. ratings.



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● TYPE PLDU POWER LINE AIR BLASTER—For spot cooling — available on pedestal. 18" to 42" in all H.P. rating.

Certified Ratings
PROPER VENTILATION IS AN INVESTMENT!
Look for this Symbol of Quality . . . →
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CHELSEA
CHELSEA FAN & BLOWER CO., Inc.
PLAINFIELD, NEW JERSEY

EDUCATIONAL EXHIBIT

(*Continued from page* 154)

● **PEOPLE**—In charge of physiological work at the University of Illinois since about 1935 is Robert W. Keeton, M. D., emeritus professor of medicine and head of the Department of Medicine. He is a member of the ASHVE Committee on Research and vice chairman of the Society's TAC on Physiological Research.

Coordinating construction and operation of the exhibit was M. K. Fahnestock, research professor of the University of Illinois, Department of Mechanical Engineering. Professor Fahnestock is a member of the ASHVE Council and chairman of the TAC on Physiological Research. Assisting in the demonstration at the exposition were George J. Oehmke of the University's Department of Mechanical Engineering, Tohru Inouye of the Department of Medicine, and others of the University staff.

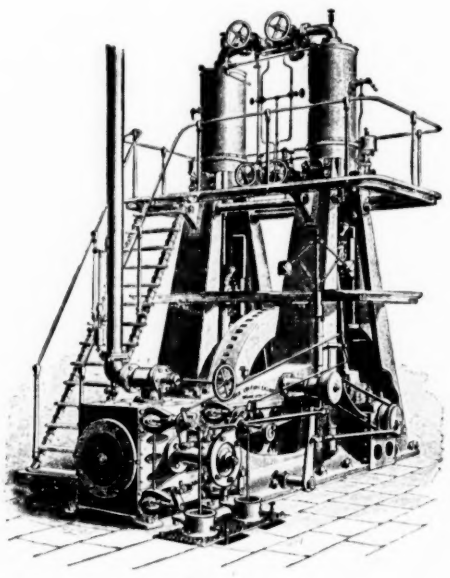
The exhibit will be shown again at a meeting of The American Medical Association in Grand Central Palace, New York City, June 1 to 5, 1953.

FRICK ANNIVERSARY

celebrates 100 years of machinery production. Steam and refrigeration company founded by George Frick.

While formal establishment of the Frick Company, Pittsburgh manufacturer of refrigeration and air conditioning machinery, took place in 1853, its actual inception in the activities of its founder, George Frick, took place in 1848 when George Frick began work on the direct predecessors of the present line of Frick machines. Mr. Frick completed his first steam engine in 1850.

(*Continued on page* 158)



By 1886 the standard Frick compressors, with Corliss-engine drive, had begun the record runs which finally totalled 40, 50 and even 60 years.

Cancer strikes 1 in 5

Strike back

Give

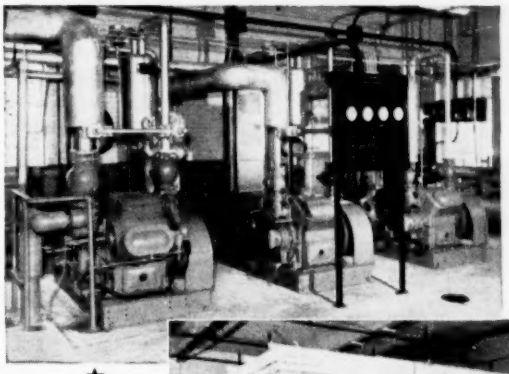
Your gifts to the American Cancer Society help guard those you love.

Your dollars support research in a hundred laboratories and universities . . . spread life-saving information . . . ease pain and suffering ...provide facilities for treatment and care of cancer patients.

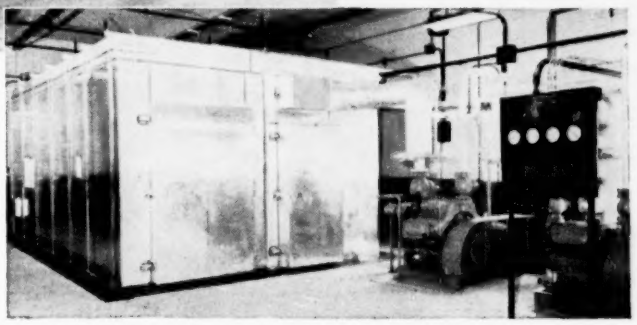
It is a sobering fact that cancer may strike anyone tomorrow: strike back today with a gift to the American Cancer Society. You may mail it, simply addressed CANCER, c/o your local post office.

American Cancer Society

it's 80° or more below zero in the Saco Lowell lab...



Thanks to VILTER



To assist its operations, the Saco Lowell Shops, manufacturers of textile machinery in Sanford, North Carolina, recently completed their low temperature test room wherein conditions must be controlled and maintained with almost hairline accuracy. The Vilter equipment is successfully producing the exact temperatures required in the special test chamber shown—temperatures of −80° F. are normal but −100° F. is not unusual.

The push-button controlled, automatically operated Vilter Freon 22 compressors at Saco Lowell are arranged for multi-stage operation with Vilter high side accessories such as intercoolers, desuperheater, condenser, etc. The low side air unit is naturally of special design for the purpose intended.

Where exacting conditions must be met, where low temperatures must be maintained unfailingly or where shut-downs may be dangerous or costly . . . there you will find Vilter Refrigeration. Vilter users know that Vilter's superb standards of operation are matched by Vilter's economy in both running and upkeep costs.

The Vilter Distributor who sold and installed the equipment is Morris & Gorrell, Inc., of Raleigh, N. C.

Write for Bulletin No. 220 or for information on the many Vilter products.

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Your nearby Vilter Representative or Distributor will be glad to show you how Vilter can help you.

REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, MILWAUKEE 7, WIS.

Air Conditioning • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Double Pipe Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pakicers • Pipe Coils • Valves & Fittings

FRICK ANNIVERSARY

(*Continued from page* 156)

● **BACKGROUND**—The whole story of the development of the Frick Company through the succeeding years is told in a centennial history which is being distributed by the company. The book is illustrated and contains matters of historical as well as engineering interest. It sells for $1 a copy.

The town of Frick, Switzerland, which was nearly 400 years old when Columbus discovered America, and the valley surrounding it were named after the ancient Frick family. The family hold authenticated records of unbroken lineage dating back to the year 1113. Jacob Frick, born in 1684, came to America about 1720 and purchased a 500 acre farm from the heirs of William Penn in Lancaster County. His great-great-grandson, George Frick was born there in 1826.

● **EQUIPMENT**—After early work on steam engines and compressors, a standard line of Frick refrigeration equipment was established in 1882. Early compressors were equipped with Corliss engine drive, and record runs of 40, 50 and even 60 years have been established by this equipment. A battery of open type compressors is still giving service at the Boston Fish Pier, though installed in 1915. Many of the Type J compressors developed in the 1920's are still running. Tapping the resources of 100 years' experience, Frick engineers have continued development and extension of the line to fit modern requirements in both heavy duty refrigeration and the lighter unit air conditioning equipment.

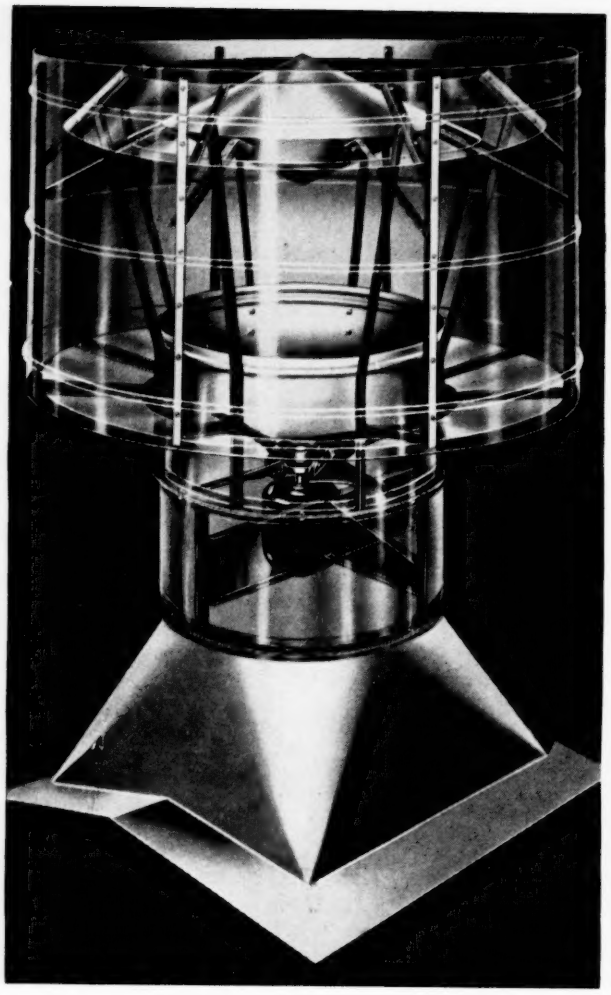
NEWS BRIEFS

• Appointment of Robert Friedel as staff specialist in charge of the residential air conditioning program has been announced by Airtemp Div., Chrysler Corp. Mr. Friedel, for seven years regional sales manager of the New York office, will direct promotion and sales of residential air conditioning with home builders and dealers.

• Charles Arthur Booth, seventy-six, executive vice president of Buffalo Forge Company, Buffalo, N. Y., died in Buffalo General Hospital after a short illness. Mr. Booth, a graduate of Worcester Polytechnic Institute, started with the company in 1900, became sales manager in 1907, and vice president and director about 1917. Mr. Booth was a past president of the National Association of Fan Manufacturers and a member of ASME and ASHVE.

• Appointment of Richard J. Crouse as general manager of the first factory completed in a $100,000 expansion program for the National Heater Co., Inc., St. Paul, Minn., has been announced. Mr. Crouse was formerly assistant manager in the heating department of Snelling Co., St. Paul. The new $33,000 one-story addition will house facilities for the wiring, assembly and check-out of space heaters produced by the firm.

(*Continued on page* 160)



PROVIDE ECONOMICAL TWO-WAY VENTILATION WITH

BURT FREE-FLOW FAN VENTILATORS

Many structures do not require full time power ventilation. For them, Burt's Free-Flow Fan Ventilator is both economical and efficient because it supplies all normal exhaust needs by gravity. But, when greater exhaust is required, its Axial Flow Burt Airfoil Fan accelerates almost six times the removal of extra heat and impurities. It provides positive controlled ventilation. See Sweet's for further details or write for Bulletin SPV-10A.

FAN & GRAVITY VENTILATORS • LOUVERS • SHEET METAL SPECIALTIES

The Burt Manufacturing Company

49 E. South Street, Akron 11, Ohio

SPEED WORK ON RUSH PIPING PROJECTS

CONTRACTOR INGENUITY — By using a suspension boom, here is how one contractor saved time by welding five 21-ft. Ric-wiL units together above-ground before lowering into trench.

WITH RIC-WIL PREFABRICATED INSULATED PIPING

SPEED "on-the-job" is a major factor in the installation of underground piping — from the standpoint of costs, man hours, and interruption of vital utility services.

Whether you are piping steam, hot water, oil, or process liquids, Ric-wiL prefabricated units are designed for quick, economical installation. Furnished in 21-ft. lengths, pipe and insulation per job specifications are pre-assembled inside a heavy-duty conduit housing for permanent protection and high efficiency.

FORM 5205 will acquaint you with the complete range of Ric-wiL piping systems and related products. Furnished on request.

Ric-wiL PREFABRICATED INSULATED PIPING

UNDERGROUND OR OVERHEAD

THE RIC-WIL COMPANY · CLEVELAND, O.

LOW INSTALLATION

AND MAINTENANCE COSTS

. . . plus added years

of dependable service

★

TODD BURNERS

GAS OR OIL

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COMBUSTION EQUIPMENT DIVISION

TODD SHIPYARDS CORPORATION

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Elmhurst, Queens, N. Y.

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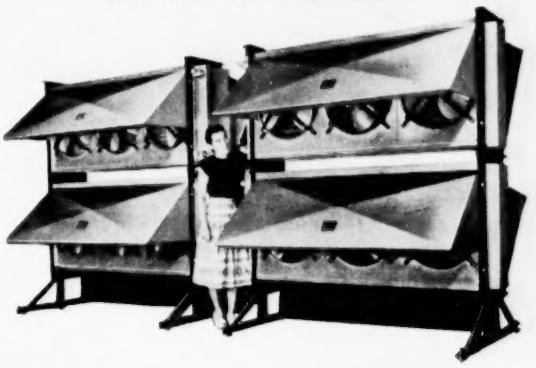
3/4 TO 100 H.P.

CONDENSING

...without water!

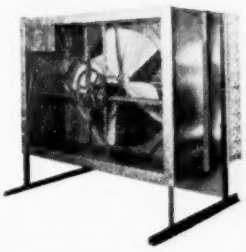
ANY SIZE COMPRESSOR CAN BE AIR COOLED



with 40 TON

UNICON*

by KRAMER



Eliminates all water problems . . . because you don't use water with UNICON! Stands, hoods and wind deflectors are available for simplified outside mounting.

20 TON

WRITE FOR BULLETIN U-210

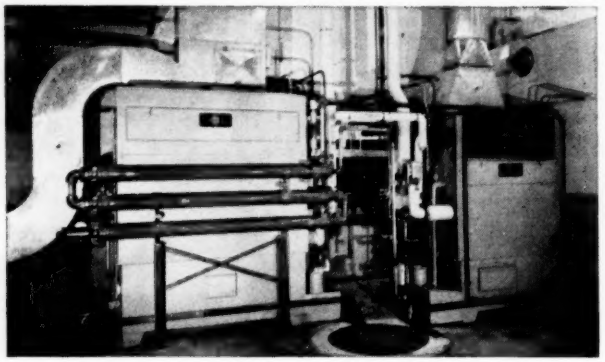
*Patent Pending

KRAMER TRENTON CO.

Trenton 5, N.J.

This NEW METHOD DRIES AIR

PRECISELY AS YOU WANT IT



NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

Most compact, taking less space for installation.

Inexpensive to operate because . . . no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

For complete information write

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

Dept. HV, 405 Lexington Ave. New York 17, N. Y.

Sales Engineers in Principal Cities of U. S. and Canada

(*Continued from page* 158)

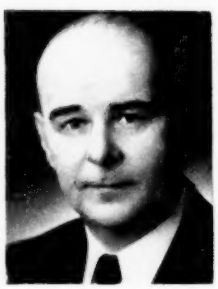
• National Association of Fan Manufacturers, Inc., and Propeller Fan Manufacturers' Association announce the adoption of test procedures for power roof-ventilators having either centrifugal or axial type wheels. The object of such tests is to obtain performance for published data and for general application. Test procedures are outlined in Bulletin No. 110, The Standard Test Code for Centrifugal and Axial Fans and Bulletin No. 113, Laboratory Standards.

• The National Radiator Co., Johnstown, Pa., announced that K. O. Schlentner, formerly assistant manager of research, has been named manager of heating research. Dr. W. M. Shafer, who was in charge of metallurgical and chemical research, has been made manager of metals research. Mr. Schlentner joined the company in 1936. He has served on various committees of Institute of Boiler and Radiator Manufacturers and ASHVE, particularly on those charged with the development of various testing codes. Dr. Shafer, who came to the firm in 1946 as a metallurgist and chemist, received his Ph.D. from the University of Illinois.

• Appointment of Walter Schmidt as director of engineering of Air Conditioning Div., Remington Corporation, was announced. Prior to joining the firm, Mr. Schmidt was chief engineer of Koch Refrigerators, Inc., and previously was with Refrigerated Cabinet Div., Anheuser-Busch; Deepfreeze Div., Motor Products Corp.; and Air Conditioning and Commercial Refrigeration Div., General Motors Corp.

• Robert E. Cassatt, advertising manager of Fedders-Quigan Corp., has been named sales manager of the firm's refrigeration appliances division. Mr. Cassatt joined the company three years ago. He previously had served with the General Electric Company as advertising and sales promotion manager of the specialty division and sales promotion manager of the receiver division.

GETTING PERSONAL



G. W. Heumann

Gerhart W. Heumann (*Starters for Industrial Type Alternating Current Motors, page* 111) consulting engineer, Industry Control Department of General Electric Company, was born in Dresden, Germany. He obtained his degree in electrical engineering from Technical University and worked on industrial equipment for Siemens-Schuckert, Berlin, Germany, for three years.

Mr. Heumann came to the United States in 1926 and joined the Westinghouse Electric Corp., as power transmission engineer.

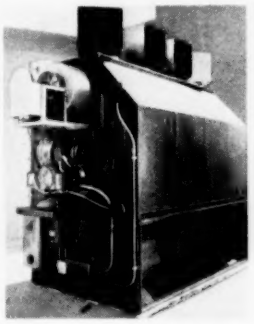
(*Continued on page* 162)

ADV.

SPACE HEATER MEETS TESTING FIRM SPECS

National Champion direct-fired Heaters —heavy and light oil series—Accepted for Listing by Underwriters' Laboratories, Inc.

Listing by Underwriters' Laboratories, Inc., national testing organization, of the National Champion direct-fired Space Heaters, heavy and light oil series, has been announced by Tim J. Costello, president of the National Heater Company, national manufacturers of oil, gas and combination oil-gas fired heating equipment with headquarters in St. Paul, Minnesota.



Equipment listed by the testing firm meets requirements for safety both from the standpoint of electrical control sequence and the safe fire box surface and casing temperatures to qualify on minimum clearance specifications.

Designed for large area heating, National Champion units are produced in 12 models with capacities ranging from 200,000 to 2,000,000 BTU per hour.

Heavy duty industrial units

Prominent in the National Champion line is the Model "H", a vertical unit equipped with discharge heads, specifically designed for permanent spot heating of large enclosed areas or for use in industrial and commercial construction where permanent heating facilities have yet to be installed.

The National Champion line also includes the Model "D", a highly compact unit specifically engineered for the requirements of central heating systems essential in churches, schools, auditoriums and offices.

Specialized for specific problems

Other heaters in the line are the Model "I", an inverted unit with heat discharge at the bottom; Model "C", a horizontal ceiling suspension heater; Model "P", a portable unit with capacities from 200,000 to 1,800,000 BTU per hour; and the Model "S", a unit similar to the Model "D" but with side-mounted blowers.

All National Champion heaters incorporate the famous teardrop design stainless steel firebox, are of welded one-piece steel construction and utilize to advantage the direct flame-metal-air principle of heat transfer for maximum efficiency.

Burner units listed

All National Champion oil burners are pressure type and carry additional U.L. Listing for added safety. Electronic flame failure control is standard equipment. All units are wire and flame tested at the factory before shipment.

Information and specifications are available upon request from the National Heater Company, 2184 Cleora Avenue, St. Paul 4, Minnesota.

NATIONAL HEATER COMPANY
Dept. B
2184 Cleora Avenue -:- St. Paul 4, Minnesota

DEERING does it AGAIN!

WORLD'S SMALLEST ROOM AIR CONDITIONER, YET PACKED WITH MORE CAPACITY PER H. P.

FITS ALL STEEL AND ALUMINUM CASEMENT WINDOWS WITHOUT ALTERATIONS

Here is a room air conditioner that will be in big demand this year. This is your opportunity to make DEERING your complete room air conditioner line. Send coupon today for YOUR franchise.

The DEERING can be installed in just one window opening as small as 10¼" high and 14½" wide. It can be installed in less than 30 minutes by service man or customer. It requires no special framing, window brackets or wing adapters — no installation kit needed. Just slide-in . . . hook-in and plug-in. NO WINDOW MULLIONS AND MUNTINS ALTERED, MUTILATED OR DESTROYED, no drilling, cutting or filing.

The only unit that meets all demands, because . . . **THERE IS NOT A WINDOW MADE (CASEMENT OR DOUBLE HUNG) THAT THE DEERING WILL NOT FIT.**

The deering AIR CONDITIONING CO.
CINCINNATI 2, OHIO

ACT NOW! PROFIT IN 1953 FROM A BRAND NEW DIMENSION IN ROOM AIR CONDITIONING

Yes! I am interested in a franchise for the DEERING casement window room air conditioner. Please rush me full information.

Name_____
Company_____
Position_____
City_____ Zone____ State____

MAIL TODAY TO
THE DEERING AIR CONDITIONING COMPANY
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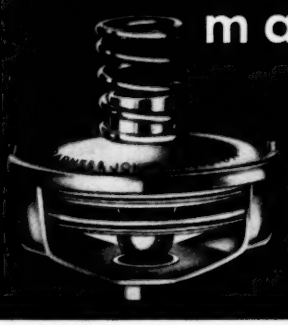
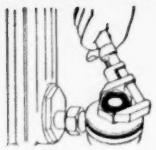
—in 2 minutes

old steam traps made new!



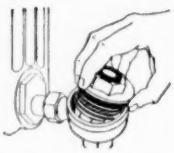


Close the radiator supply valve and remove the trap cover with a monkey wrench.

Three simple motions will make a brand new steam trap without disturbing the pipe connections. The B & J cage unit can be supplied to fit any make of trap—any pressure up to 100 pounds. It eliminates guess work.

It is complete in one piece and even replaces the old valve seat. It has given outstanding service for years in B & J radiator traps. No field adjustment necessary.

Other exclusive B & J specialties include a new Proportionator Control System for vapor heating, an adjustable orifice valve for steam systems, and many styles and sizes of steam traps, all distinguished by the B & J patented thermostatic unit. Bulletins on request.



Remove old element (usually screwed into the cover). Clean surface around the seat. Remove the old seat if necessary according to instructions accompanying all shipments.

Place the new B & J cage replacement unit in position. Clean seating surfaces of cover and body and replace cover.

Send for this booklet and, if you wish, a free sample of a cage unit that will fit your traps — state make, pipe size, model no. and pressure.

7-G

for Quality

B&J **Barnes & Jones** INCORPORATED

REPRESENTATIVES IN PRINCIPAL CITIES

BOSTON 30, MASSACHUSETTS

(*Continued from page* 160)

For two years he served as liaison engineer for German General Electric Company at Schenectady and in 1931 joined the Industrial Control Engineering Department of G-E. He worked on design and application of control equipment in many applications. He was appointed to his present position in 1952.

Mr. Heumann is the author of a book on Magnetic Control of Industrial Motors and 27 papers and articles on control subjects. He is a member of A.I.E.E., past chairman of Committee on Industrial Control, and presently vice-chairman of the Industry Division Committee. He is also a member of the National Electrical Manufacturers' Association.

F. Y. Carter (*Sizing the Expansion Valve in Air Conditioning Systems*, page 93) is a 1931 graduate of the College of Engineering, University of Kentucky.

Following graduation he served as test engineer for the Detroit Lubricator Company and later was advanced to supervisor of refrigeration research. He transferred to the sales department in 1945 and he was chief sales engineer of the Refrigeration Division until July, 1952. Mr. Carter, at that time, was advanced to manager of the division.

He has been granted many U. S. patents on refrigeration control devices.

Canadian Degree-Days for February, 1953*

City	February		Cumulative	
	1953	Normal	1952-53	Normal
Calgary, Alta.	1113	1355	6039	6666
Charlottetown, P.E.I.	1131	1338	5164	5166
Crescent Valley, B. C.	889	1112	4772	5743
Edmonton, Alta.	1209	1501	6648	7299
Fort William, Ont.	1484	1582	5819	7204
Grande Prairie, Alta.	1246	1456	7267	7456
Halifax, N. S.	983	1170	4414	5068
London, Ont.	1025	1240	4867	5253
Medicine Hat, Alta.	1053	1406	5612	6438
Moncton, B. C.	1154	1392	5542	6106
Montreal, P. Q.	1195	1460	5377	6108
North Bay, Ont.	1322	1492	6344	6653
Ottawa, Ont.	1221	1459	6657	6382
Penticton, B. C.	798	969	4041	4779
Porquis Junction, Ont.	1568	1764	7380	8064
Prince George, B. C.	1081	1305	6271	6677
Quebec City, P. Q.	1271	1481	5864	6688
Regina, Sask.	1491	1764	7175	8137
St. John, N. B.	1148	1266	5041	5652
Saskatoon, Sask.	1540	1635	7378	7911
Toronto, Ont.	967	1206	4406	5154
Vancouver, B. C.	683	736	3408	3797
Victoria, B. C.	650	689	3274	3414
Windsor, Ont.	936	1148	4412	4877
Winnipeg, Man.	1638	1775	7215	8091

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

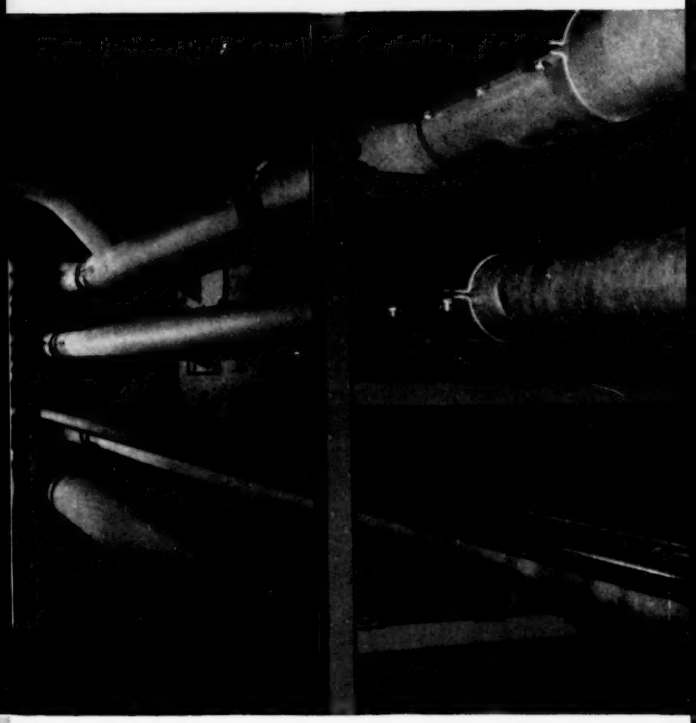
The Department reports slight revisions in the figures for January, as published in last month's issue. Corrected figures are: Crescent Valley, B. C., 961; Medicine Hat, Alta., 1528; Montreal, P. Q., 1376; Prince George, B. C., 1810.

install piping runs *with Versatile* UNISTRUT®

METAL FRAMING

The modern way to rack piping

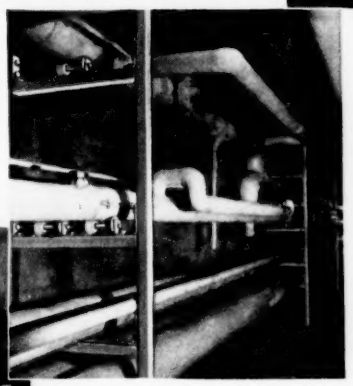
Tunnel job showing how UNISTRUT continuous run concrete inserts can be installed vertically or horizontally, or at any angle required.

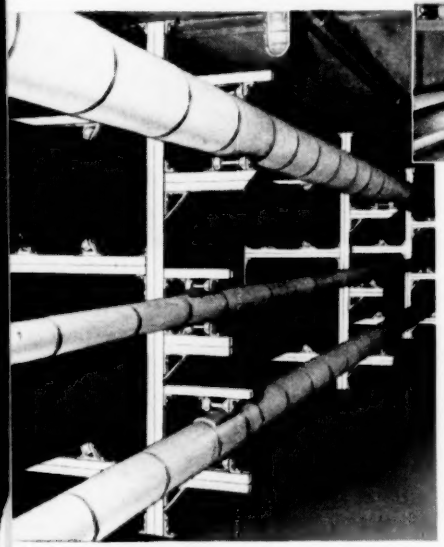


UNISTRUT Products are Bonderized

Typical piping installation supported by UNISTRUT framing, concrete inserts and roller pipe supports. Slotted channel permits attachment of fittings at any desired point.

Note how UNISTRUT framework's great strength easily supports long runs of heavy piping, including bulky 16" chilled water lines.





Adjustable Framing System

assures exact pitch, permits changes or additions at any time—no special tools or equipment needed.

Conserves Steel, Reduces Manpower Hours, Cuts Over-all Costs

The UNISTRUT system of mechanical supports includes steel channel, roller pipe supports, concrete inserts, brackets, clamps, pipe hangers and many other standard parts which combine to form the world's most flexible system of support or suspension.

You save time in engineering detailing and eliminate the need for trained erection crews—you get fast, on-the-job framing assembly where adjustments are made and supporting members added as the work progresses. Try it on your next piping job!

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U. S. Patent Numbers
2327587 2329815 2345650
2363382 2380379 2405631
2541908 Other Patents Pending

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The World's Most Flexible All-Purpose Metal Framing

For the Man on the Job!
84 pages packed with photos, drawings, ideas and data on how to frame, mount, rack, hang and support all kinds of mechanical and electrical equipment with adjustable UNISTRUT metal framing.

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AIRFOIL* FINNED RADIATION

for INDUSTRIAL • COMMERCIAL • INSTITUTIONAL HEATING!

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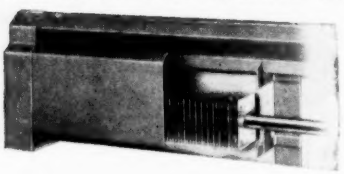
Improved airfoil design gives greater heating efficiency in every kind of steam or hot water installation. Four sizes — with fins of cold rolled steel mechanically bonded to steel pipe — meet every heating requirement. Easily installed with expanded metal grilles or Radiant-Ray Brand CUSTOM-FIT Enclosures.

EXPANDED METAL GRILLE

Write for catalog and specification sheets . . . today!

BY THE MAKERS OF FAMOUS RADIANT•RAY BRAND BASEBOARD HEATING



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ABSTRACTS OF TECHNICAL PAPERS

Following are abstracts of some of the technical papers presented at the last annual ASHVE meeting. Other abstracts were published in the previous issue of HEATING AND VENTILATING.

Fuel Consumption in Low-Cost Housing

Rutcher Skagerberg and J. E. Phifer, respectively, director and assistant director, Operations Engineering Branch, Housing and Home Finance Agency, presented a paper on Fuel Consumption Analysis for Multi-Family Housing Projects. The data was collected from 1938 to 1949 to determine any significant trends.

The authors stated that underground pipeline losses constitute a relatively large part of the heating load of a central system and deserve consideration, particularly from the viewpoint of central plant adaptability to projects of low density with long underground lines.

High density projects, compared to low density projects, consume less fuel with central plants, and where they do not adapt themselves to individual heating, should be considered for central plant heating.

With average operation, a saving of 15% in fuel can be expected where there is automatic control of the distribution of steam to dwellings in housing projects. Greater returns can be expected where operators are fully instructed, cooperative and under good management.

Heat Exchanges in Ceiling Panel

C. M. Humphreys, G. V. Parmelee and L. F. Schutrum, members of the ASHVE research laboratory, described in a paper, Heat Exchanges in a Ceiling Panel Heated Room, results of experimental studies in the Environment Laboratory.

Most tests, reported in the study, were made with the floor and walls at a uniform surface temperature. Heat exchange rates between the heated ceiling and the colder surfaces were given by the authors. Results were also reported for a few exploratory tests in which the unheated surfaces were at non-uniform temperatures, and the effects of infiltration on room air temperatures and ceiling panel heat flow were given. Some conclusions, as the result of these tests, follow:

(1) The total heat output of the ceiling panel was much lower than is given in some presently used design methods. This seems to be due principally to the fact that the convection conductances for the ceiling panel appear to be much lower than presently published data would indicate.

(2) Heat flow due to radiant exchange between a given surface and the rest of the room may be opposite in direction to the heat flow, due to the convective exchange between the surface and the ambient air.

(3) The surface temperatures of neutral walls were not necessarily the same as the temperature of the ambient air but were dependent upon the heat balance between the radiative and convective heat exchangs.

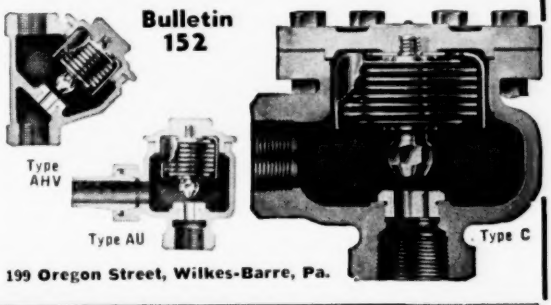
(4) For this room, a definite relattionship was estabtablished between room surface temperatures, infiltration air rate and temperature, and the temperature of the room air at the 60-inch level.

(*Continued on page* 166)

NICHOLSON TRAPS

SAVE CAR OF COAL WEEKLY

Following replacement of all steam traps, of various makes, with Nicholson units, an Eastern college reports "an average coal saving of 1 carload per week besides much better heat distribution." Credit is given the higher and more even temperatures which Nicholson traps effect. See why large industrial and institutional steam users are increasingly standardizing on Nicholsons. 5 types; for heat, power, process; sizes ¼" to 2"; press. to 250 lbs.



Bulletin 152

199 Oregon Street, Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

The biggest "FAN CLUB" in America is made up of leading Heating and Ventilating Engineers who specify HERMAN NELSON PROPELLER FANS!

Send your "FAN MAIL" to:

American Air Filter
COMPANY INC
215 Central Avenue
Louisville 8, Kentucky

Heating Costs for Six Buildings Cut $5,493.38 By Steam-Pak Generator

PEARCE, MAYER & GREER
Real Estate
Insurance

December 10, 1952

Arlen Oil-Heat, Inc.
1259 Washington Avenue
New York 56, New York

Re: 2754 Broadway

Gentlemen:

A year has passed since your installation of a York-Shipley Steam-Pak combination boiler and oil burner.

We are pleased to advise you that oil consumption was under your guarantee, and as a matter of fact some 20% under our estimated figure. The actual cost for oil was $7,906.62 against an average of $9,300.00 per annum as a coal cost for the three previous years.

It must be remembered, however, that the one oil burner installation took the place of two steam and one hot water heating coal fired boilers.

We also, as you know, have been able to do away with the services of one man at a saving of approximately $1,000.00 a year. Actually, the cost of the equipment will be saved in two years.

May we also say that we are completely satisfied with the operation of the equipment itself. There were only several service calls for minor adjustments during the year.

The installation and performance are excellent, and we would be pleased to recommend it to anyone in need of steam generating and hot water heating equipment.

Very truly yours,

PEARCE, MAYER & GREER

Julius Mayer
JULIUS MAYER

JM:bd

• This is but one of the cost-saving reports on Steam-Pak Generators, which are built for high or low pressure work in a complete range of sizes from 15 to 300 hp. with oil, gas, or combination firing.

YORK-SHIPLEY, INC. - Industrial Division, York 4, Pa.

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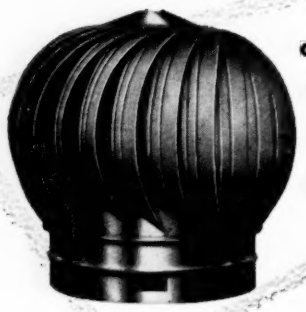

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the WESTERN ROTARY continues to exhaust during wind lulls by kinetic energy.

Lifetime guaranteed bearings—bearings that stay in alignment. Both bearings mounted on same axis. Long-lasting metallic-leafing paint finish on durable galvanized steel. Clean, low modern silhouette, completely functional. Throat sizes 6" thru 48" . . . Order today from your wholesaler. Write for prices, specifications, other information. In 1952 Sweet's, A.E.C., Heating, Ventilating & Air Conditioning Guide.

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THIS . . . practical booklet is based on extensive experience in working with architects and heating engineers. Illustrated with on-the-job photos and helpful diagrams—replete with suggestions that will save you time, trouble and cost. Send coupon now.

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43-50 Tenth Street, Long Island City, N. Y.

Please send me booklet on radiant heat pipe layout.

Name.....Title.....

Firm.....

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City.....Zone.....State.....

(*Continued from page* 164)

(5) For constant values of ceiling temperature and average unheated surface temperature, the difference between the area-weighted average temperature of all the room surfaces, and room temperature, increased as the rate of infiltration increased and as the temperature of the infiltration air decreased.

Effectiveness of Slat-type Shades

Results of research on the effectiveness of slat-type shades in reducing heat gain through sunlit glass were presented in a paper prepared by G. V. Parmelee, W. W. Aubele and D. J. Vilt, all of the ASHVE research laboratory. Experiments were conducted to study the transmittance and absorptance of solar radiation by four different slat-type sun shades.

The principal factors studied were shade color, slat width, slat spacing ratio, slat angle and the position of the sun. Transmittance, absorptance and reflectance curves for a number of specific sun-shade glass combinations were given as functions of the sun's position, which was described by the profile or shadow line angle.

Cooling a Small Residence

Research into the problem of summer cooling was conducted in Warm Air Heating Research Residence No. 2 at the University of Illinois and the results reported in a paper, Cooling a Small Residence with a Two-Horsepower Mechanical Condensing Unit, by H. T. Gilkey, research associate, D. R. Bahnfleth, research assistant, and R. W. Roose, research assistant professor of mechanical engineering, all of the departmeent of mechanical engineering, University of Illinois.

A 2-ton condensing unit was installed in the residence and connected to the air distribution system that was designed for warm air heating. Ventilation air was mechanically introduced into the return air side of the system at the rate of one air change per hour and the blower was operated continuously.

The unit operated a total of 419 hours during the period from June 7, 1952 to July 4, 1952, and during that time the unit consumed 57,700 gallons of water and during this same period, the blower motor and compressor used respectively 836 kwh and 229 kwh. The paper reports various phases of this research and has tables and graphs of the operating data.

Pressure Losses

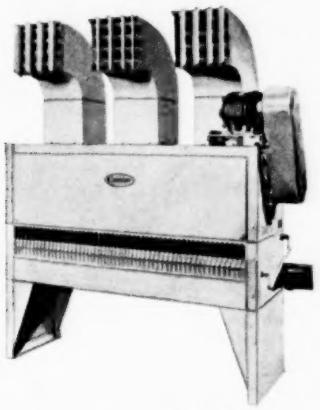
The results of an investigation of the pressure losses due to friction which occur when the air flows in small galvanized round pipes and fittings were reported by H. G. Conn, W. G. Colborne and W. G. Brown of Queen's University, Kingston, Ont., Canada, in a paper, Pressure Losses in 4-Inch Diameter Galvanized Metal Duct and Fittings.

This work was considered necessary due to the advent of 3½ and 4-inch diameter air distribution ducts for which there was much needed data on pressure losses.

Investigations were made on runs of piping which in-

(*Continued on page* 168)

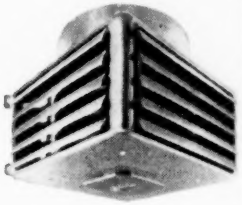
Lowest cost heat for large areas...



Carrier Heat Diffusers

Carrier blower-type Heat Diffusers heat *and* ventilate large enclosed areas in factories, warehouses, hangars, garages. Floor, wall or ceiling mounted models. Sectionalized. Quickly altered. Deliver air in practically any direction. For use with steam or hot water. There are 6 sizes to 2,390,000 Btu's. Air handling capacities from 4000 to 31,000 cfm.

For steam or hot water, Carrier propeller-fan type Unit Heaters are available in two models. Four-way Directed-flo vertical model (illustrated below, left) gives quick heat from higher ceilings, discharges in any of 4 directions. 7 sizes from 82,000 to 500,000 Btu's. Horizontal model directs warmed air from heights of 15 to 18 feet. Aerofin coil one row deep with widely spaced fins offers less air resistance, makes cleaning easier. There are 10 sizes from 21,000 to 200,000 Btu's.

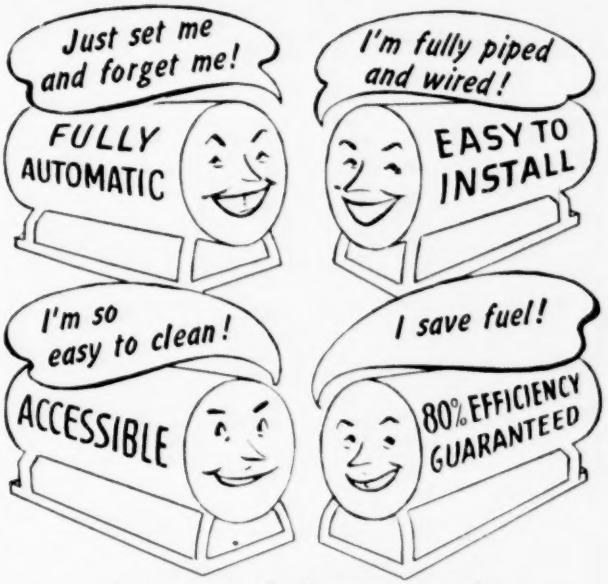


Where gas is available, Carrier Gas-fired Unit Heaters give clean, economical heat. Propeller-fan model (above, right) and duct type both feature one-piece heat exchanger and combustion chamber of Aluminized Steel for extra years of better heat. AGA approved for all types of gas. There are 7 sizes from 70,000 to 230,000 Btu's.

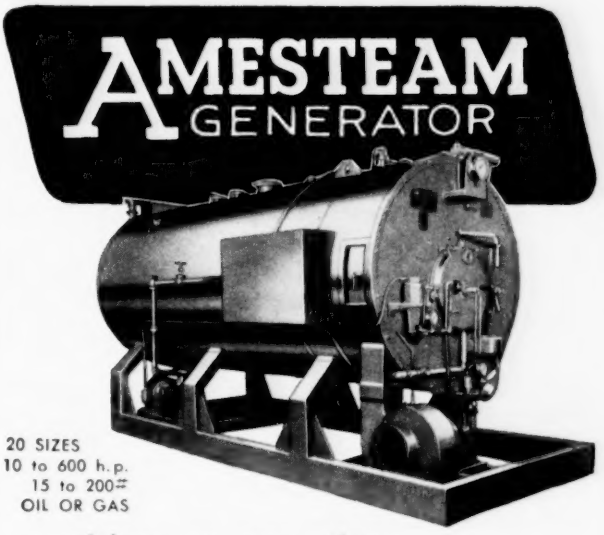
Give your customers more heat for the money. Write Carrier Corporation, Syracuse, New York.

Carrier

AIR CONDITIONING • REFRIGERATION • INDUSTRIAL HEATING



— Just some of the reasons why so many users prefer



20 SIZES
10 to 600 h.p.
15 to 200#
OIL OR GAS

— and here are some others:

★ Eye-level controls — protected from dirt, water and accidental damage

★ AMES SERVICE — our **LOCAL** service man starts your unit and provides 3 months' FREE SERVICE

WRITE FOR THIS FREE BULLETIN ON CUTTING STEAM COSTS!

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COMPANY .....

ADDRESS .....

AMES IRON WORKS INC.

BOX E-43 OSWEGO, N. Y.

Builders of Better Boilers since 1848

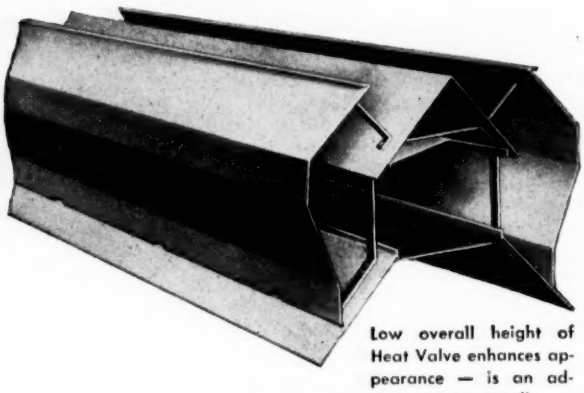
Simple, practical ventilation for many kinds of buildings

The *original* continuous ventilator

The Heat Valve as developed and improved by Swartwout has proved to be one of the most adaptable ventilator designs. Originally applied principally to ridge peaks, its use on slopes or flat roof surfaces has become common. Popular uses in the smaller sizes include saw-tooth construction and skylights.

Heat Valve is designed for maximum capacity with lowest friction, and greatest assistance from outside air currents. It provides practically any area of roof opening desired, at economical cost. Can be quickly and easily installed. Always weatherproof, with fully adjustable damper for exhaust control when needed. Various damper operating methods are available.

Swartwout-Dexter Heat Valve is made in 10 throat sizes, in standard 10 ft. lengths. Can be made of special materials when acid or fume conditions prevail . . . Get the full story — write for Bulletin HV-F.



Low overall height of Heat Valve enhances appearance — is an advantage structuraliy.

18511 Euclid Avenue, Cleveland 12, Ohio

The Swartwout Co.

Roof Ventilators and Ventilating Louvers

POWER PLANT EQUIPMENT • PROCESS INDUSTRY CONTROLS

(*Continued from page 166*)

cluded several different fittings and the variations between the predicted losses and the actual losses analyzed. The velocity profile between fittings was studied in an attempt to find an explanation of the variations.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

HEALTH CONFERENCE—1953 Industrial Health Conference at the Hotel Statler, Los Angeles, Calif. A joint conference of six groups, including the American Industrial Hygiene Association. Dr. Henry Smythe, Jr., Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh 13, Pa. . . . . **APRIL 18-25, 1953.**

OIL HEAT CONVENTION—Thirty-first annual convention of the Oil-Heat Institute of America, at Edgewater Beach Hotel, Chicago, Ill. R. H. L. Becker, managing director, of the Institute, 6 E. 39th St., New York 16, N. Y. . . **APRIL 20-22, 1953.**

MASTER PLUMBERS CONVENTION—71st annual convention and exposition of the National Association of Master Plumbers, at Municipal Auditorium, Kansas City, Mo. Oliver F. Erickson, Secretary-Treasurer, National Association of Master Plumbers of the U. S., Inc., 1016-20th Street, N. W., Washington, D. C. . . . . **MAY 6-9, 1953.**

HEATING CONTRACTORS MEETING—64th annual convention of the Heating, Piping and Air Conditioning Contractors National Association, at Edgewater Beach Hotel, Chicago, Ill. Joseph C. Fitts, secretary of the Association, 1250 Avenue of the Americas, New York 20, N. Y. . . . . **MAY 13-16, 1953.**

MATERIALS HANDLING EXPOSITION—5th National Materials Handling Exposition, sponsored by The Material Handling Institute, at Convention Hall, Philadelphia, Pa. A series of conferences to be held by the American Materials Handling Society concurrently with the exposition. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. . . **MAY 18-22, 1953.**

GAMA MEETING—Annual meeting of the Gas Appliance Manufacturers Association, at The Greenbrier Hotel, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director, 60 E. 42nd St., New York N. Y. . . . . **MAY 20-22, 1953.**

OIL HEAT EXPOSITION—1953 Eastern Biennial Exposition of Oil Heat, sponsored by Oil Heat Institute of New England, at the Hotel Statler, Boston, Mass. F. M. Beckwith, secretary of the Institute, 839 Beacon St., Boston 15, Mass. . . . . **JUNE 2-5, 1953.**

AUTOMOTIVE ENGINEERS MEETING—1953 SAE summer meeting at The Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J. Secretary, Society of Automotive Engineers, 29 W. 39th St., New York, N. Y. . . . . **JUNE 7-12, 1953.**

NDHA MEETING—44th annual meeting of the National District Heating Association, at Lookout Mountain Hotel, Chattanooga, Tenn. John F. Collins, secretary of the Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. . . . . **JUNE 9-12, 1953.**

TESTING MATERIALS MEETING—Annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **JUNE 21-25, 1953.**

ASRE MEETING—Spring meeting of the American Society of Refrigerating Engineers, at the Lake Placid Club, Lake Placid, N. Y. M. C. Turpin, secretary of the Society, 40 W. 40th St., New York, N. Y. . . . . **JUNE 27—JULY 1, 1953.**

ASHVE MEETING—1953 semi-annual meeting of the American Society of Heating and Ventilating Engineers, at the Cosmopolitan Hotel, Denver, Colo. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **JUNE 29—JULY 1, 1953**

INSTRUMENT EXHIBIT—8th National Instrument Conference and Exhibit of the Instrument Society of America, at the Sherman Hotel, Chicago, Ill. John McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 33, Pa. . . . . **SEPTEMBER 21-25, 1953.**

AGA CONFERENCE—Annual conference of the American Gas Association, at Kiel Auditorium, St. Louis, Mo. Secretary of the Association, 420 Lexington Ave., New York, N. Y. . . . . **OCTOBER 26-28, 1953.**

PALMER

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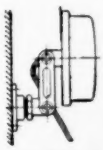
Rigid Stem Dial Thermometer

Rigid stem tapered bulb, interchangeable with standard industrial thermometer separable socket.



2

Wall Mounted Dial Thermometer

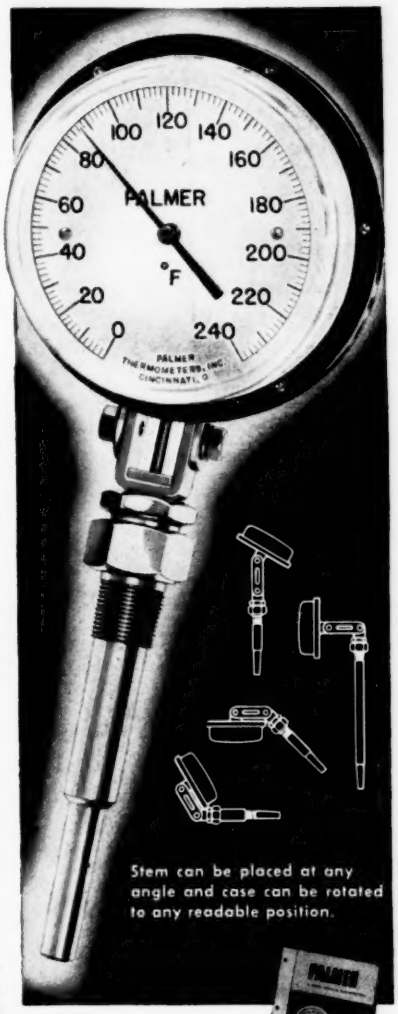
Wall mounted dial thermometer with flexible connecting armor. Case adjustable to easy reading position.

3

Flush Mounted Dial Thermometer

Flush mounted style for panel mounting with flexible connecting armor.

All three types have a full 4½" dial Face



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For details on the New Palmer Dial Thermometer, please write for Palmer Bulletin 51-129.

for accuracy: Mercury actuated . . . Fully Compensated by Invar Compensation. Guaranteed Accurate 1 scale division.

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for readability: Bold Black Numbers . . . 11" of scale Reading Dial face can always be placed in easiest readable position.

for interchangeability: Always specify "PALMER" Separable sockets as they are interchangeable for Dial or Industrial type Thermometers.

PALMER THERMOMETERS, INC.
Mfrs. of Industrial Laboratory Recording and Dial Thermometers
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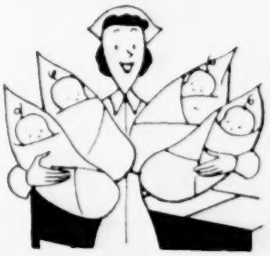

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INCREASES YOUR PROFITS

4 Ways!

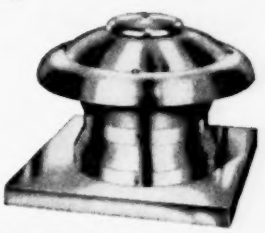
1 ASSURES SUCCESSFUL BIDS! For successful bids on ventilating jobs, you must offer your customers the best . . . but at a reasonable price. Premium-quality Jenn-Air ventilating equipment meets both these requirements. To suit any job, Jenn-Air is available in single and two-speed models, as well as explosion-proof for hazardous locations.

POWER WALL EXHAUSTER

2 SLASHES SHIPPING COSTS! Jenn-Air's (strength without weight) all-aluminum construction provides a 3 to 1 weight advantage over ordinary steel construction . . . really saves money on shipping costs.

3 REDUCES INSTALLATION TIME! Jenn-Air ventilating equipment is shipped to you assembled and ready for installation. Its package-unit design requires no special fittings. Easiest of all power exhausters to handle and install, Jenn-Air cuts job time to a minimum.

4 SATISFIES YOUR CUSTOMERS! Jenn-Air silently draws out dust, heat, and fumes efficiently and quickly. It stays clean longer, requires no painting. Jenn-Air means customer satisfaction, resulting in more praise for your work and more ventilating jobs.



POWER ROOF EXHAUSTER

For complete technical data, installation information, and performance records, send now for free illustrated brochure, c/o Dept. V-4.

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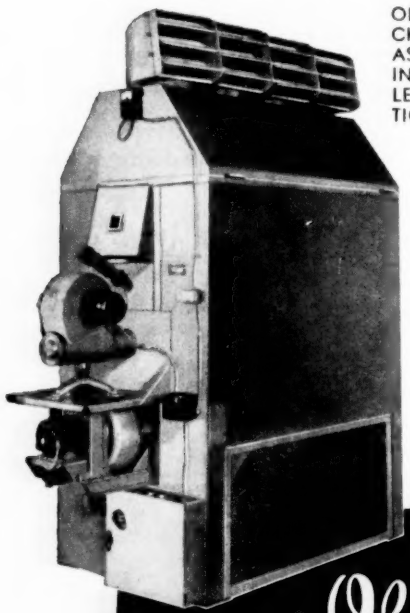
IT'S BETTER ON THE OUTSIDE

ALL OLSON HEATER ACCESSORIES ARE MOUNTED OUTSIDE THE HEATER WHERE THEY CAN BE SERVICED WITHOUT DISMANTLING THE UNIT. A BEARING, FOR EXAMPLE, MAY BE REPLACED IN A FEW MINUTES WITHOUT PROLONGED INTERRUPTION OF HEAT SUPPLY.

OLSON ENGINEERS WILL CHEERFULLY GIVE THEIR ASSISTANCE ON HEATING PROBLEMS REGARDLESS OF SIZE OR LOCATION.



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Gas, Oil, Coal or Dual Gas and Oil
BROAD ST. · CANFIELD, OHIO

WRITE FOR COMPLETE INFORMATION AND DATA SHEET SHOWING HORIZONTAL AND INVERTED MODELS, STOKER FIRED AND DUCT UNITS.

DEGREE-DAYS FOR FEBRUARY, 1953

(A) Airport readings; (C) city office readings;
(O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 25th Year of Publication of Monthly Degree-Day Data

City	February		
	1953	1952	Normal
Abilene, Texas (A)	435	356	510
Albany, New York (A)	1005	1094	1142
Albuquerque, New Mexico (A)	732	738	642
Alpena, Michigan (C)	1111	1170	1278
Anaconda, Montana (C)	1035	1129	1164
Asheville, North Carolina (C)	631	613	756
Atlanta, Georgia (C)	485	459	557
Atlantic City, New Jersey (C)	684	754	904
Augusta, Georgia (A)	407	414	423
Baker, Oregon (C)	913	1147	991
Baltimore, Maryland (C)	636	681	843
Billings, Montana (A)	906	1043	1120
Binghamton, New York (C)	898	1023	1182
Birmingham, Alabama (A)	441	423	521
Bismarck, North Dakota (A)	1193	1373	1548
Block Island, Rhode Island (A)	796	902	983
Boise, Idaho (A)	796	995	848
Boston, Massachusetts (A)	834	935	1042
Bozeman, Montana (C)	1049	1193	1208
Buffalo, New York (A)	956	1036	1156
Burlington, Iowa (A)	895	917	(a)
Burlington, Vermont (A)	1099	1175	1294
Butte, Montana (C)	1073	1248	1143
Cairo, Illinois (C)	593	576	762
Canton, New York	(a)		
Charleston, South Carolina (C)	290	342	372
Charlotte, North Carolina (C)	497	556	588
Chattanooga, Tennessee (A)	538	551	602
Cheyenne, Wyoming (A)	1042	1046	1075
Chicago, Illinois (C)	894	904	1039
Cincinnati, Ohio (C)	660	728	862
Cleveland, Ohio (A)	874	947	1075
Columbia, Missouri (A)	705	772	897
Columbia, South Carolina (C)	381	404	498
Columbus, Ohio (C)	809	832	980
Concord, New Hampshire (A)	1040	1163	1240
Concordia, Kansas (C)	731	775	970
Dallas, Texas (A)	406	313	493
Davenport, Iowa (C)	(a)	927	1140
Dayton, Ohio (A)	841	900	980
Deer Lodge, Montana (C)	963	1159	1175
Denver, Colorado (C)	897	865	918
Des Moines, Iowa (A)	985	942	1173
Detroit, Michigan (A)	913	1031	1134
Devils Lake, North Dakota (C)	1360	1384	1551
Dodge City, Kansas (A)	725	758	890
Dubuque, Iowa (C)	1100	1038	1218
Duluth, Minnesota (C)	1438	1266	1464
Eastport, Maine (A)	1045	1122	1232
Elkins, West Virginia (A)	853	854	991
El Paso, Texas (A)	468	499	434
Ely, Nevada (A)	954	1300	(a)
Erie, Pennsylvania (C)	857	961	1098
Escanaba, Michigan (C)	1239	1202	1340
Evansville, Indiana (A)	682	700	854
Fargo, North Dakota	1360	1401	1606
Fort Smith, Arkansas (A)	554	505	630
Fort Wayne, Indiana (A)	919	951	1098
Fort Worth, Texas (A)	394	311	498
Fresno, California (A)	459	432	389
Galveston, Texas (C)	253	159	255
Grand Junction, Colorado (A)	887	968	863
Grand Rapids, Michigan (A)	983	1004	1204
Green Bay, Wisconsin (C)	1290	1233	1358
Greensboro, North Carolina (A)	574	646	678
Greenville, South Carolina (A)	499	527	661
Harrisburg, Pennsylvania (A)	754	822	1008
Hartford, Connecticut (A)	850	960	1100
Hatteras, North Carolina (C)	408	429	535
Havre, Montana (C)	1011	1253	1450
Helena, Montana (A)	979	1216	1178
Houston, Texas (C)	252	176	277
Huron, South Dakota (A)	1222	1229	1340
Indianapolis, Indiana (A)	815	817	969
Jackson, Mississippi (A)	391	307	(a)
Kansas City, Missouri (A)	(a)	781	946
Knoxville, Tennessee (A)	560	560	666
La Crosse, Wisconsin (A)	1239	1135	1265
Lander, Wyoming (A)	1135	1176	1155

(a) Data not available.

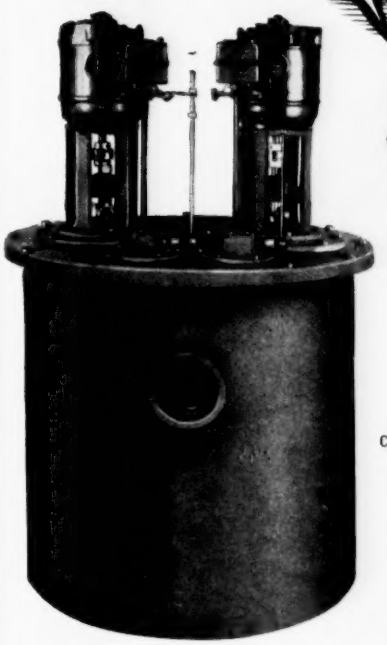
City	February		
	1953	1952	Normal
Lansing, Michigan (A)	987	1081	1201
Lewiston, Maine (O)	1021	1113	1243
Lincoln, Nebraska (C)	839	846	1131
Little Rock, Arkansas (A)	508	432	582
Livingston, Montana (C)	951	1009	1067
Los Angeles, California (C)	180	182	266
Louisville, Kentucky (A)	661	699	801
Lynchburg, Virginia (A)	635	678	730
Macon, Georgia (A)	386	365	462
Madison, Wisconsin (C)	1115	1074	1299
Marquette, Michigan (C)	1214	1199	1361
Memphis, Tennessee (A)	506	474	599
Meridian, Mississippi (A)	410	314	456
Milwaukee, Wisconsin (A)	1043	1043	1201
Minneapolis, Minnesota (A)	1313	1192	1400
Moline, Illinois (A)	(a)	967	(a)
Montgomery, Alabama (A)	374	335	392
Nantucket, Massachusetts (A)	819	909	974
Nashville, Tennessee (A)	583	565	675
New Haven, Connecticut (A)	824	911	1011
New Orleans, Louisiana (C)	222	166	230
New York, New York (C)	755	821	953
Newark, New Jersey (A)	763	842	1002
Norfolk, Virginia (C)	481	565	650
North Head, Washington (C)	561	673	622
North Platte, Nebraska (A)	984	960	1020
Oakland, California (C)	391	401	403
Oklahoma City, Oklahoma (C)	559	544	742
Omaha, Nebraska (A)	921	886	1126
Oswego, New York (C)	984	1050	1162
Parkersburg, West Virginia (C)	721	766	879
Peoria, Illinois (A)	1125	1163	1067
Philadelphia, Pennsylvania (C)	693	752	881
Phoenix, Arizona (C)	267	281	263
Pittsburgh, Pennsylvania (C)	752	809	944
Pocatello, Idaho (A)	879	1239	986
Portland, Maine (A)	1041	1123	1162
Portland, Oregon (C)	544	642	644
Providence, Rhode Island (C)	801	915	1070
Pueblo, Colorado (A)	847	812	916
Raleigh, North Carolina (C)	503	528	630
Rapid City, South Dakota (A)	1095	1102	1119
Reading, Pennsylvania (C)	734	783	980
Red Bluff, California (A)	379	463	(a)
Reno, Nevada (A)	819	843	823
Richmond, Virginia (C)	561	630	695
Rochester, New York (A)	968	1050	1159
Roswell, New Mexico (A)	617	574	580
Sacramento, California (C)	367	444	426
St. Joseph, Missouri (A)	766	799	974
St. Louis, Missouri (C)	652	701	854
Salt Lake City, Utah (A)	779	1052	885
San Antonio, Texas (A)	297	197	274
San Diego, California (A)	223	206	280
Sandusky, Ohio (C)	855	946	1061
San Francisco, California (C)	300	365	356
Sault Ste. Marie, Michigan (A)	1270	1308	1487
Savannah, Georgia (A)	300	322	316
Scranton, Pennsylvania (C)	864	949	1106
Seattle, Washington (C)	576	602	647
Sheridan, Wyoming (A)	1020	1137	1160
Shreveport, Louisiana (A)	394	310	412
Sioux City, Iowa (A)	1105	982	1260
Spokane, Washington (A)	834	1002	952
Springfield, Illinois (C)	775	802	1008
Springfield, Missouri (A)	675	699	876
Syracuse, New York (A)	988	1081	1212
Tacoma, Washington (C)	610	651	675
Terre Haute, Indiana (A)	792	807	966
Toledo, Ohio (A)	921	995	1075
Topeka, Kansas (C)	685	746	935
Trenton, New Jersey (C)	741	818	941
Utica, New York (O)	1042	1111	1181
Valentine, Nebraska (C)	1090	1038	1130
Walla Walla, Washington (C)	598	692	778
Washington, D. C. (C)	617	679	848
Wichita, Kansas (A)	670	704	896
Williston, North Dakota (C)	1210	1356	1495
Winnemucca, Nevada (C)	(a)	912	905
Yakima, Washington (A)	698	876	846

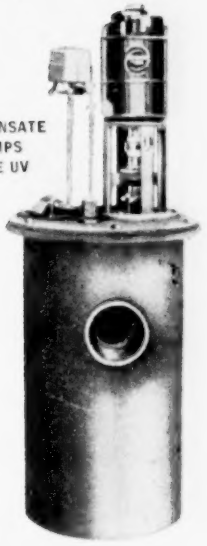
(a) Data not available.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

PUT THE RIGHT PUMP ON THE JOB

duplex ? ? single





CONDENSATE PUMPS TYPE UV

Make the Choice a

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. . you can be sure of dependable, efficient performance every time.

Heating engineers specify Skidmore Pumps . . . *Skidmore Pumps are backed by over a quarter of a century of heating-pump "know-how."*

The Type UV Pump is recommended for low returns . . . the single unit will give dependable service under normal operating conditions . . . the duplex unit is recommended for heavy duty and all-around performance.

Tell us your heating problems, our engineers will give their recommendations without obligations. Write for bulletin No. 19-A.

SKIDMORE CORPORATION
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SKIDMORE PUMPS

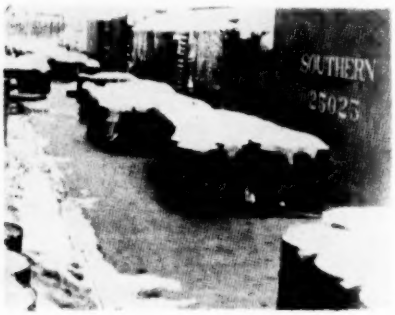
It Pays to Learn About Snow Melting Systems

The subject may interest you as a designer, or an installer, or as a plant or building operator; but whatever phase you are concerned with, snow removal by buried hot water pipes is an important development with a big future.

THE COST of shoveling snow is the least important consideration in installing snow melting systems. This is especially true in industrial and commercial applications. For example, on the loading platform shown below a snow melting system prevents accidents and eliminates lost time. A service area dry and free of snow piles means more business for a gas station. A dry sidewalk in front of a store attracts patrons to the window displays, and keeps entrances dry and safe.

Snow melting systems can be profitably installed in:

- Sidewalks in front of stores and office buildings
- Loading platforms
- Automobile or pedestrian ramps
- Hospital driveways
- Service stations
- Airport runways
- Hazardous stretches of highways
- Residence driveways and walks



Information on snow melting has been scattered and fragmentary, but now reliable data on every phase of the subject are available in "Snow Melting" by T. Napier Adlam. This book tells: 1. How to decide if a snow melting system should be used. 2. What kind of a system to employ. 3.

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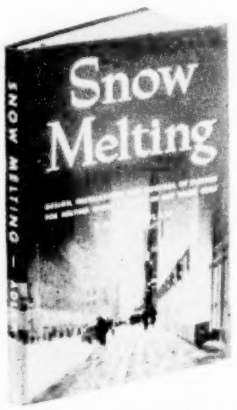

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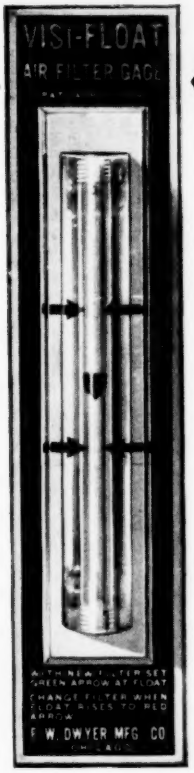

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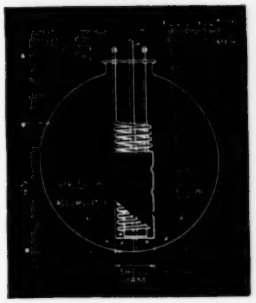

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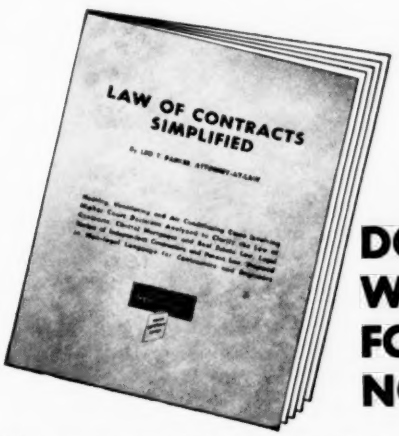

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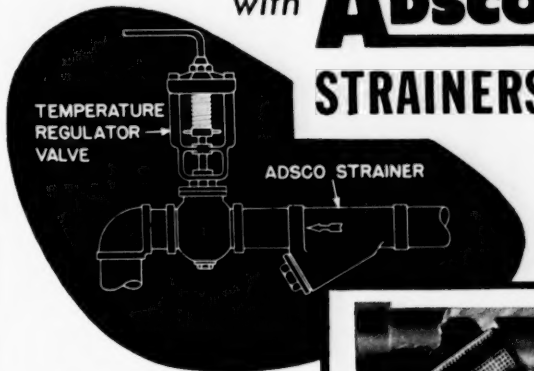

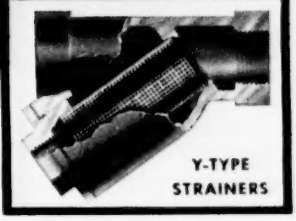

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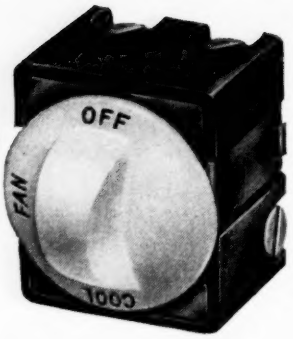

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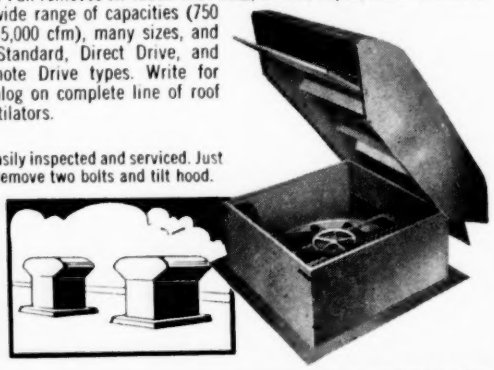

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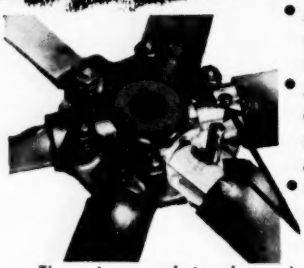

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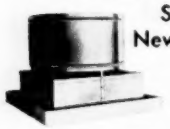

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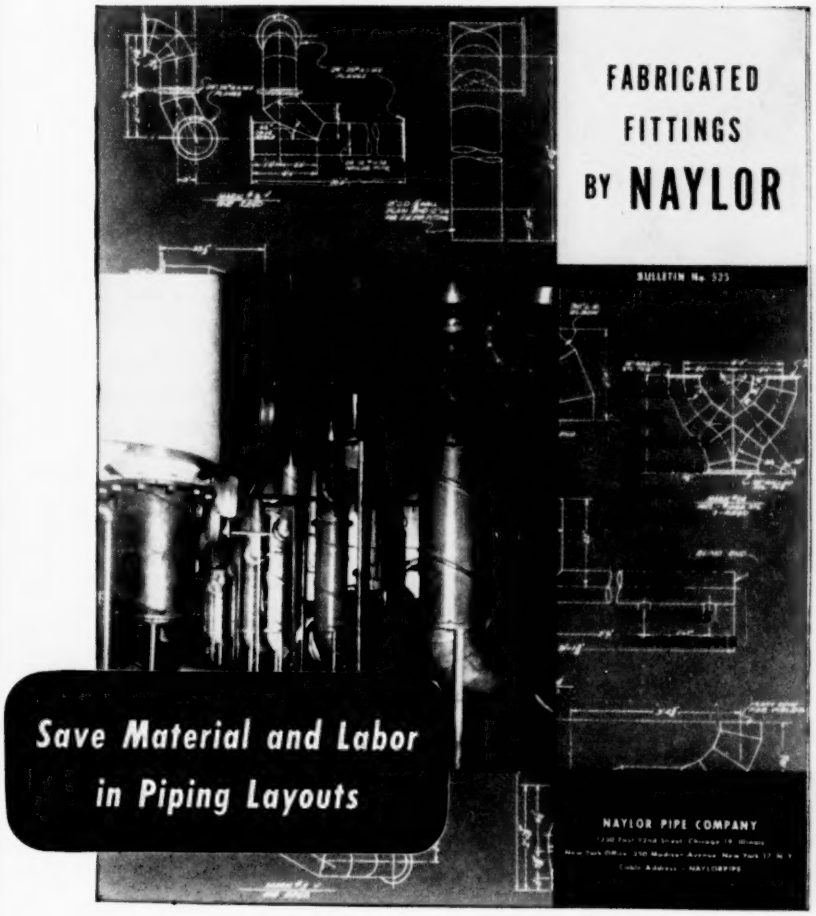

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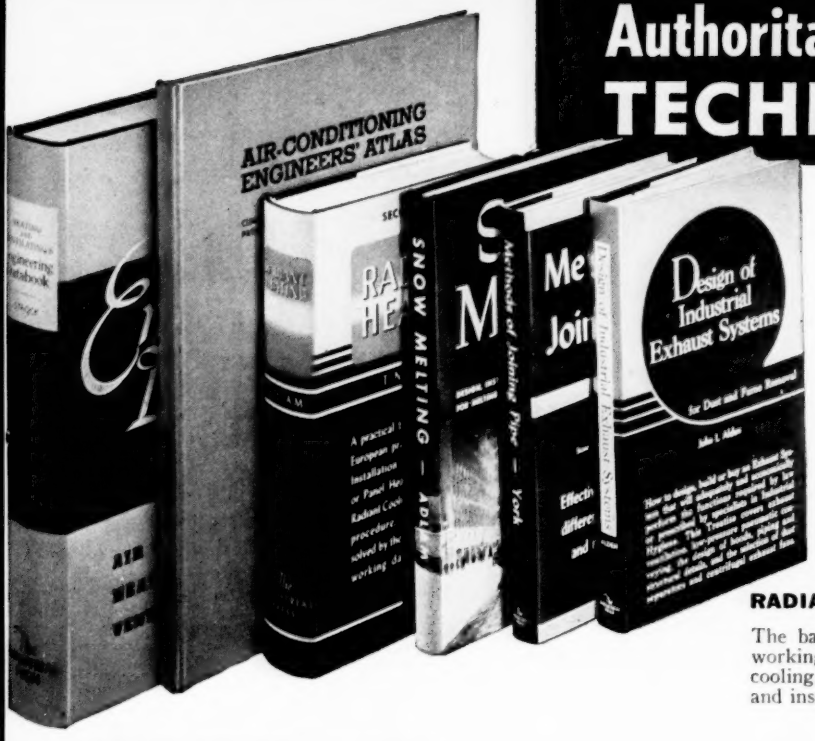

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*Advertisement appeared in preceding issue.

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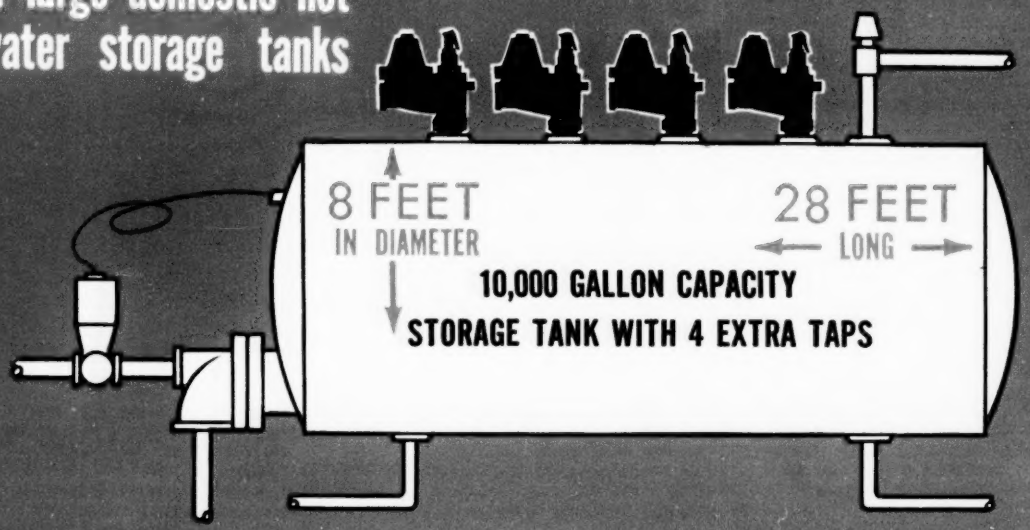
of large domestic hot water storage tanks



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AIR CONDITIONING DESIGN DATA FOR FOOD INDUSTRIES

The data which follow, collected by Nathan N. Wolpert, supplement and add to those previously published on sheets entitled Air Conditioning Design Data for Industrial Plants.

Bakery Products

Heat generated in the dough mixers used in bakeries will cause burning unless the mixer is cooled by chilled air or brine at 33-38F.

In fermentation rooms, air conditions should be held at 78-80F and 75% R. H. Temperatures below 80F will reduce yeast cell development. It is important that a relative humidity of 75% be maintained to prevent absorption or release of moisture by the dough. High relative humidity will cause slimy dough and stickiness when handled. Air of low relative humidity will cause crustiness, prevent the release of gas, and will form blow holes and lumps. Air must be so distributed to the fermentation room that drafts, cold spots and overheated areas are eliminated.

For proofing, the usual satisfactory condition is 90F and 85% R. H. Loss of product weight can be prevented by cooling for 80 to 120 minutes at a temperature of 70 to 75F and 65% R. H.

While best storage conditions for flour is 78F and 75% R. H., a humidity of 13% is best for the maturing or aging period. Malt, yeast and shortening is best stored at 40F, while the waxed paper for wrapping should be held in stock at 50-60F.

Beer and Ale

One brewer blows air through coils of cold brine and the cooled air is then delivered to the front of aging and fermenting tanks to maintain temperatures as low as 32F. An air cooling system is used in preference to a system of circulating cooled brine to eliminate the inconvenience that results from frost accumulation on pipe and blower type evaporators. In areas where the aging and fermenting tanks are located, water is used for washing floors and tanks. As a result, with a direct expansion system of air conditioning, considerable frost would accumulate. The air cooling system succeeds in bringing down relative humidity although no attempt is made to control this moisture to a definite range.

Butter Processing

Desirable air conditions for butter processing ranges from a minmium of 65F and 35% R. H. in winter to 75F and 50% R. H. in summer.

These conditions are in the range of normal comfort for people working at machines and also within the range necessary to maintain the quality, body and texture of the product. Although it is possible to exceed 50% R. H., excessive condensation will result in some of the packaging machines, and a contaminating influence may be promoted.

Chocolate

In producing fine ground chocolate, a supply of cooling water is important to counteract the heat produced by friction during grinding. For a 50 hp motor, about 20 gpm cooling water at 35F is required in an 80F room. Where the room temperature is above 80F, add about 5 gpm to this amount. Water should not be colder than 55F nor warmer than 75F to keep the rolls at the proper temperature. Should the rolls be too cold, they will shrink in size so that some of the chocolate will pass through the rolls without refining. If the rolls run too warm, the metal will expand and the rolls will become too tight, resulting in crystallization of the sugar content, followed by scorching of the chocolate.

Chocolate Candy

For cooling chocolates, there should be little temperature differential between the temperature of the candy and the air in the cooling tunnel. If the temperature is held below 40F, the chocolate may become discolored due to moisture condensing from the warmer air. Air flow should be calculated to prevent more than a 10F rise between the entering air and the outlet air. Best results are produced where the direction of air flow is opposite the candy travel; when the warmer air strikes the warmest candy as it enters the cooler, the finish of the chocolate is improved.

Crackers and Biscuits

One manufacturer of crackers and biscuits has found it helpful to keep the packaging department temperature at 70-72F, with the relative humidity from 50-53%. Not only do these air conditions maintain the products in a fresh and palatable condition, but they produce comfort for the workers.

Hygroscopic Material

Substances as hygroscopic as dried molasses, or dried orange and lemon powders must be handled and packaged in atmospheres not exceeding 20% R. H. Soluble coffee should be packed and handled in atmospheres containing not over 30% R. H.

Macaroni and Spaghetti

The control of air conditions in the macaroni industry is a very important phase of production. Drying of both long macaroni and spaghetti is carried on normally in enclosed rooms and requires from 30 to 96 hours per batch, depending on the degree of control exercised. For the shorter drying rates, a very close control is required and the control temperatures are held constant throughout the drying process. For example, see Table 1, which gives both dry bulb and wet bulb temperatures for three products.

TABLE 1—CONDITIONS FOR DRYING MACARONI AND SPAGHETTI

Stage of Drying	Product and Process					
	Long Goods in Batch Dryers		Short Goods, Continuous Drying		Noodles—Continuous Drying	
	Dry Bulb, F	Wet Bulb, F	Dry Bulb, F	Wet Bulb, F	Dry Bulb, F	Wet Bulb, F
Preliminary	90	80	100	85	90	82
Mid-period	90	84	95	87	100	88
End	85	73	90	78	100	88

Macaroni, spaghetti and noodles are hygroscopic materials and will pick up or lose moisture, depending on the moisture content of the surrounding air. For quality control, a moisture content of about 11% is desirable, corresponding to an equilibrium condition of 50% R. H. Therefore, in the packaging room, and in the storage rooms, a relative humidity of 50% should be maintained. Unfortunately, not too many macaroni plants make any attempt to control humidity in the packaging rooms.

Another reason why humidity should be maintained in packaging rooms is that the cellophane and cardboard cartons are easier to handle and stand up better.

In the manufacturing area where the semolina flour and water are mixed, and the macaroni is extruded, it is important to keep this room warm and relatively humid—somewhere between 45 and 55% R. H.

Meat and Meat Products

Aside from the information given in Table 3, which is a tabulation for an entire industry, one meat packer has found the conditions listed in Table 2 satisfactory for their processing and packaging departments.

During hog chilling, while the final cooler temperature is 28F and the minimum relative humidity is 85%, the relative humidity is much higher during the first part of the cooling cycle. Throughout the cooler, there are from 1 to 1.5 air changes per minute.

Aside from the areas listed in Table 2, satisfactory humidities are maintained to avoid excessive dryness. However, reheat is necessary to provide air of low humidity and comfort for employes in the wrapping rooms and in the dry sausage drying rooms.

Air conditioning is necessary for a wide variety of processes and products in meat packing plants. Each type of meat requires special air conditions. Table 3 lists the suggested air conditions for various processes and rooms in meat packing plants.

TABLE 2—AIR CONDITIONS FOR MEAT PROCESSING

Process Room or Area	Temperature, F	Relative Humidity, %
Drying room for dry sausage	53-54	72-73
Bacon slicing and packaging	55	60*
Beef holding cooler	33-34	85
Fresh pork cooler	34-38	85
Sausage wrapping	55	60*
Hog chilling—final temperature	28	88

*Steps are being taken to reduce this to 40% R. H.

TABLE 3—AIR CONDITIONS IN MEAT PACKING PLANTS*

Room or Process	Temperature F	Relative Humidity, %
Beef		
Chill	30-32	85-90
Curing	36-38	85-90
Car Shipping	33-35	84-87
Aging	33-35	85-87
Boning	40-45	80-85
Cutting	33-36	80-85
Bacon		
Chilling	10-28	80-85
Molding	32-34	80-85
Slicing	50-55	50-55
Calf cooler	34-36	85-90
Cooked ham cooler	35-40	80-85
Canned ham cooler	32-38	75-80
Canning meats chill	20-38	75-80
Dried beef cooler	36-38	60-65
Dry salt curing cellar	36-38	85-90
Hogs		
Chill	28-32	85-90
Cutting	50-60	60-70
Cuts grading	45-50	60-75
Lard		
Shipping of shortening	48-50	65-70
Packaging	50-55	60-65
Leak-lard cooler	28-30	80-85
Loading dock—Shipping	40-45	65-70
Offal cooler	33-35	85-90
Oleo shipping	48-50	65-70
Pigs feet, curing	40-45	85-90
Pork cuts, fresh	26-30	80-85
Sausage, dry		
Meat curing	38-40	80-85
Stuffing	55-60	65-70
Grinding	40-45	80-85
Sausage, fresh		
Manufacture	55-60	65-70
Packaging cooler	40-45	80-85
Sausage		
Grinding	40-45	80-85
Stuffing	55-60	65-70
Pre-chill	38-40	80-85
Packaging	40-45	80-85
Sheep-lamb chill	34-36	85-90
Smoked meats wrapping and shipping	60-65	60-70
Veal chilling	34-36	85-90

*From Meat Packers Guide.

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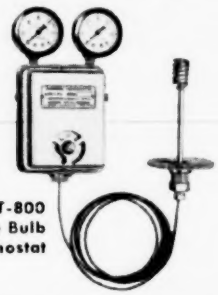
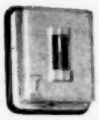
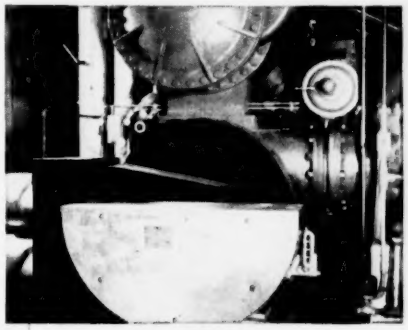


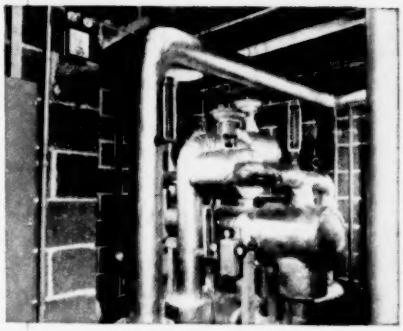
T-800
Remote Bulb
Master Thermostat



T-432
Heating-Cooling
Room Thermostat



Johnson T-901 Remote Bulb Submaster Thermostats, readjusted by S-222 Gradual Switches, control the capacity of each of two 350-ton Carrier centrifugal refrigerating machines that furnish chilled water for the cooling system.



Behind the scenes, in machine rooms, Johnson T-800 Master Remote Bulb Thermostats, measuring the outdoor temperature, readjust T-901 Submaster Thermostats which control V-185 Valves on the steam supply to the converters.

Hotel guest rooms have units supplied, during the heating season, with hot water and, during the cooling season, with chilled water controlled by Johnson Submaster instruments. Many individual offices in the building have Johnson T-432 Heating-Cooling Room Thermostats in addition.

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